ECOLOGICAL CHALLENGES TO SUSTAINABLE AGRICULTURAL DEVELOPMENT
A CASE STUDY OF GHAZIABAD DISTRICT

DISSERTATION SUBMITTED FOR THE AWARD OF THE DEGREE OF

Master of Philosophy

IN

GEOGRAPHY

BY

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UNDER THE SUPERVISION OF

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2003

Dedicated To My Parents

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Certificate

Certified that **Miss RENU KUMARI**, Research student of this department has carried out her M. Phil Dissertation on **"Ecological Challenges to Sustainable Agricultural Development - A Case study of Ghaziabad District"**.

The dissertation may be placed for evaluation in partial fulfillment of the degree of Master of Philosophy (M. Phil in Geography)

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(RENU KUMARI)

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CHAPTER- I

INTRODUCTION

CONCEPTUAL FRAMEWORK

The term "Sustainable Development" was first used when the environmental hazards were, first time linked with the process of development in 1972 at the Stockholm Conference on Human Environment where the third world countries raised the cry that "poverty was the greatest polluters". By 1980, the concept had firmly established itself and the World Commission Strategy of the International Union for conservation of Nature and Natural Resources **(IUCN), 1980)** emphasized the need for conservation of living resources to achieve sustainable development , be it in agriculture or in industry.

The term 'Sustainability' which was missing until recently in the dictionaries, has now become an important word after **"the limits of growth"** in the early 1970's which discussed whether or not continuing economic growth would inevitably lead to severe environmental degradation and societal collapse on a global scale. The literary meaning of sustainability is to maintain, to uphold and to upkeep the production steadily. In the encyclopedia of Agricultural science, sustainable agriculture refers to a mode of farming that attempts to provide long term sustained yields through the use of ecologically sound management technologies such as crop diversification, organic soil management and biological pest control.

According to the Oxford Dictionary, "Sustainability" means endurance under perpetual stress. In agriculture, sustainability refers to endurance of agricultural resource base under conditions of constant pressure. Thus, the Sustainability of agriculture may be defined as the maintenance of agricultural resource base in

permanent healthy condition and regular development of superior quality and high yielding plants and animals through genetic manipulations so that enough food of good quality continues to flow from it for all times to meet the requirement of the present and future population. According to this definition, Sustainability have three perspectives: (i) maintenance of agricultural resource base in indefinite healthy condition, (ii) evolvement of new hybrid plants and crossbreed animals for higher yields and quality products, (iii) population control .

Allen (1980) defined "sustained development as development that is likely to lasting satisfaction of human needs and improvement of quality of human life."

Godland and Ledec (1987) defined "Sustainable Development as a pattern of social and structural economic transformations which optimizes the economic and societal benefits available in the present, without jeopardizing the likely potential for similar benefits in the future." A primary goal of sustainable development is to achieve a reasonable and equitably distributed level of economic well being that can be perpetuated continually for many human generations". "... Sustainable Development implies using renewable natural resources in a manner which does not eliminate or degrade them, or otherwise their usefulness for future generation ... Sustainable development also implies depleting non renewable energy resources at a slow enough rate so as to ensure the high probability of an orderly societal transition to renewable energy sources.

Redcliff (1987) defined the sustainable development as "It requires a broader view of both economics and ecology that most practitioner in either discipline are prepared to admit, together with political commitment to ensure that development is sustainable."

The concept of sustainable development came into existence in a broader view after the report of the World Commission on

Environmental and Development **(WCED)** "Brundtland Report" in 1987 and it has been defined in the report of united Nation as "Sustainable development is a development that meets the needs of present generations without compromising the ability of future generations to meet their own needs". It means that the natural resources base must not be destroyed to such an extent that life on the earth becomes impossible.

Barbier (1987) summarized that "The concept of sustainable economic development as applied to the Third World... is directly concerned with increasing the material standard of living of the poor at the grassroot level, which can be quantitatively measured in terms of increased food, real income, educational services, health care, sanitation and water supply, emerging stocks of food and cash, etc., and only indirectly concerned with economic growth at the aggregate, commonly national level. In general terms, the primary objective is reducing the absolute poverty of the world's poor through providing lasting and secure livelihoods that minimize resource depletion, environmental degradation, cultural disruption and social instability."

Perrings, (1987) 'Sustainability' in general means 'survival' keeping the community alive and it is more often than not used a prefix to development stemming from the main hypothesis of the limits to growth which emphasized the aspects of limits to land availability and its per unit productivity, to the pollution nature can absorb and recycle and also to the technological changes, the sustainability requires the development to meet the needs of present without compromising the ability of the future, it means stress on sustainable economic action keeping intergenerational equity in the mind.

Tolba (1987) explain the concept of sustainable development in broader terms such as:

(i) help for the very poor because they are left with no option other than to destroy their environment;

(ii) the idea of self-reliant development, within natural resource constraints;

(iii) the idea of cost-effective development using different economic criteria to the traditional approach; that is to say development should not degrade environmental quality, not should it reduce productivity in the long run;

(iv) the great issues of health control, appropriate technologies, food self-reliance, clean water and shelter for all;

(v) the notion that people-centred initiatives are needed human beings in the words, are the resources in the concept;

Daly (1988), defined the sustainability from ecological point of view refers to the existence of ecological conditions necessary to support human life at the specified level of well-being through future generation.

Conway, G. (1988), developed four indicators of sustainable development which were economic than ecological. They are (i) Productivity measured in terms of yield or net income, (ii) Stability of yield or net income, (iii) Sustainability of yield or net income, (iv) Equatability in terms of income distribution. As per these indicators Conway defined 'Sustainability' refers to " the propensity of a system to withstand viability of a system." (Tisdell, 1988)

Conway, G. and Barbier (1988), agricultural sustainability has been defined as ' the ability to maintain productivity ... in the face of stress or shock'.

Harwood (1988), defined Sustainable agriculture as 'an agriculture that can evolve indefinitely towards greater human utility,

greater efficiency of resource use and a balance with the environment that is favourable to humans and most other species.

According to Markandya and Pearce (1988), "... Sustainability ought to mean that a given stock or resources – trees, soil quality, water and so on – should not decline." As well as "... Sustainability might be redefined in terms of a requirement that the use of resources today should not reduce real incomes in the future..."

O' Riordan (1988), stated " Sustainability" in much broader phenomenon, embracing ethical norms pertaining to the survival of living matter, to the rights of future generations and to institutions responsible for ensuring that such rights are fully taken into account in policies and actions.

Swaminathan, M.S. (1989), the eminent agricultural scientist defined the sustainable agriculture as "the system that is economically viable, (low inputs, feasibility of farms), technologically appropriate (low cost, local adaptability, temporal stability, resources use efficiency, renewability), environmental friendly (bio-diversity, non – degradation of natural resource), social acceptable (employment, power generation, needs, cultural values and politically and administrative manageable (equity and productivity) is called sustainable." Thus, sustainability has ecological, economical, social cultural, political and management dimensions.

Thus, a sustainable landuse system requires farm systems for consideration viz. purchased inputs (socio – economic environmental); resource productivity and system production. Therefore, the inputs that will not negatively effect the environment or system and regenerate the natural resource, but are not economically viable, will not be adopted by farmers (Pezzy, 1989).

According to FAO (1989), Sustainable Agriculture involves successful management of resources for increased agriculture production to satisfy changing human needs while maintaining or enhancing the environment and natural resources.

Anonymous (1989), Sustainable Agriculture may be defined as the one that over the long- term, enhance the environmental quality and resource base on which agriculture depends, provides for human needs of food, fibre and fodder, is economically viable, and enhances the quality of life for farmers and society as a whole.

According to Consultative Group on International Agriculture Research **(CGIAR)** in 1989 "Sustainable agriculture is the successful management of resources to satisfy the changing human needs, while maintaining or enhancing the quality of environment and conserving natural resources." The ultimate goal or the needs of sustainable agriculture is to develop farming system that are productive and profitable, conserve the natural resources base, protect the environment and enhance health and safety and do so over the long term.

Harwood (1990), has defined the sustainable agriculture as "an agriculture that can evolve indefinitely towards greater human utility, greater efficiency of resource use and a balance with the environment that is favourable to humans and most other species".

Grove et al. (1990) identified six components of the conceptual framework of sustainable development, viz. adequate economic returns, maintenance of natural resources and productivity indefinitely, minimal adverse environmental impacts, optimal production with minimum external inputs, satisfaction of human needs, and provision for social needs.

Panayotou (1990) elaborated the following five conditions that all development projects, programs and policies must meet for qualifying the sustainability criteria:

1. Limit population growth rate to the level below the sum of rate of capital accumulation and technological advancements.

2. Alleviate poverty and reduce income disparities.

3. Maintain ecological balance, renewable resource base, cultural stocks, human made capital stocks and the assimilative capacity of the environment.

4. Avoid irreversible changes in the environment and

5. Any foreclosure of options unless near perfect substitutions, advance steps to face the risk of development interventions.

Sustainable development, therefore is not a 'de novo' thinking. It is an expanded view of conventional development evolved in more concrete terms in the recent past. It could earn recognition due to it only after it was realized that recent present directions of development are not likely to last long. This realization is substantiated by arrangements, experiences and evidences that material gains with aspirations of endless development are likely to threaten the precarious natural processes one which the very survival of mankind depends.

Evidently, sustainability is an integerated attribute of multiple vision of development ranging from local to global scale in spatial perspective and a period of few years to many generations in temporal perspective. This necessitates a radical change in the concern for development from development exclusively for ourselves and for the present generation to development for all including ourselves and for many future generations including the present era'.

Barbier and Markandya (1990), the sustainability of development process is essentially a consequence of the interaction between socio-economic and ecological system. Thus, sustainability implies consistency between socio-system and eco-system, interpreted as the long run survival of specific type of landuse. The concept of sustainability also implies seeing development as the consequences of such co-evolutionary interaction.

Chattopadhyay and Carpenter (1991) have defined "Sustainable development as a production system in which technological and management inputs do not adversely effect the bio-physical system. According to them sustainability revolves around two main questions, viz. time frame and cost. The frame according to them, is at least a generation and the ability or society to bear the cost of sustainability. Author pointed pointed out that "Sustainable development is essentially a planning process".

Dev (1991), who stated, "Sustainable agriculture in the Asian context means not less but more fertilizer – It means improvements in fertilizer use efficiency such as better nutrient balance to counter depletion of soil nutrients and soil acidification, better application techniques to improve nutrient uptake and to reduce nutrient losses, and overall improvements of crop husbandry".

Bojo (1991) views that man wants prosperity peace and security and it is the passion for these wants he interferes with the nature and natural processes. Thus, Sustainable development therefore, demands focus on environmental management as sharp as on economic management. From an economic point of view, the physical environment is a source of raw materials and energy, a source of amenities (such as recreation and beauty) and an assimilator of waste from consumption and production process.

Carring for the Earth, (1991) it was published that 'Sustainable development is a kind of development which provides real

improvements in the quality of human life and at the same time conserves the vitality and diversity of the Earth. According to them there are following eight factors which effect the sustainable development :

1. Respecting and caring for the community of life.
2. Improving the quality of life.
3. Conserving the Earth's vitality and Diversity.
4. Keeping within the Earth's carrying capacity.
5. Changing personal Attitudes and Practices.
6. Enabling communities to care for their own environment.
7. Providing a National Frame Work for integrating Development and Conservation.
8. Creating a global Alliance.

In 1992, the Earth Summits at Rio de Janerio reflected serious concern for sustainable development. According to him, "In order to achieve sustainable development environment protection shall constitute an integral part of the development process and cannot be considered in isolation from". It strongly recommended that "to achieve sustainable development and a higher quality of life for all people, states should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies."

According to Ramakrishan P.S (1992), "Sustainable agriculture not only demands efficient use of water and nutrients based on recycling of locality available resources but also regulated cropping done in a manner that would contribute towards sustainable soil fertility. In this context, the application of appropriate technology is

inevitable. Thus, the use of available bio-fertilizer is essential to retain and ameliorate the soil fertility. The sustainable development also suggests a location specific development plan.

Maurice strong (1992), defined sustainable development as "It is the process of growth that improves and enriches the quality of life, and one that is socially desirable, economically viable and ecological sound. Social desirability obviously should be the overriding concern. This social desirability criterion dictates that this sort of human development, should be of the people, for the people, by the people.

Kuhen, F. (1992) stated that, " Sustainability first of all means survival, keeping the community alive. To achieve this the main requirement is sufficient food, and the means used to this end is agriculture. According to him, sustainability also means and ecological acceptable production, where everything removed is then replaced so as not to harm the ecological system.

Mishra, D.C. (1993), the concept of sustainability in agriculture is related to agricultural production or more specifically to agricultural production systems which cover not only agricultural production but also horticulture, animal husbandry, fisheries ad forestry. Sustainable Agriculture may be defined as that agriculture which maintains the current level of activity in agriculture, notably agriculture production. According to him, seven key components of sustainable agriculture:

1. natural resource use and conservation.
2. environmental concerns.
3. integrational equity.
4. increasing needs for food, feed and fibre.

5. farmer participation

6. Policy and institutional support

7. a time frame.

According to Dahl, S.L. (1993), the World Conservation Union, United Nations Environment Programme and World Wide Fund for Nature focused both on human and biological aspects, and defined sustainability as "improving the quality of human life while living within the carrying capacity of the supporting eco-system".

Farshad, A. and Zinch (1993) stated that the concept of agricultural sustainability includes such elements as soil fertility and productivity, controlling pesticide and fertilizer pollution, management strategies, human needs, economic viability, social acceptability, ecological soundness and time-span. The major aspects which are recognized in the definition of agricultural sustainability, has been summarized below:

1. Sustainability refers to the qualitative and quantitative continuity in the use of agricultural resources.

2. Sustainable agriculture is dynamic because it is coupled with both landuse which reflects the changing needs of population and the fluctuating world economy.

3. Sustainability implies a state of equilibrium between human activities as influenced by social behaviour acquired knowledge and applied technology on the one hand and food production resources on the other. Most renewable natural resources are sustainable before human intervention.

4. Sustainability does not mean only feeding the present and future population but also requires an improved infrastructure and a stable economy. Equitability, being a

measure of human benefiaries of a system, is one of the major issues in sustainability.

5. Sustainable agriculture entails that the food production resources (soil, water, biota etc) be properly managed so that the applied practices do not cause degradation and / or pollution.

Andrew Blowers (1993), explained that, " Sustainability involves replenishing renewable resources such as soils threatened by erosion, drought or over- cultivation and conserving non- renewable resources through recycling, increased productivity or product redesign. But sustainability also require us to avoid over burdening the regenerative capacity of natural systems. Further, sustainable development involves seeking to maintain areas of high environmental quality for the general benefit and where possible, to enhance environmental quality in areas of deprivation. So, the aim of sustainable development is defined as follows:

To promote development that enhances the natural and built environmental in ways that are compartible with.

1. The requirement to conserve the stock of natural assets, wherever possible offsetting any unavoidable reduction by a compensating increase so that the total is let undiminished.

2. The need to avoid damaging the regeneration capacity of the world's natural ecosystem.

3. The need to achieve greater social equality.

4. The avoidance of the imposition of added costs or risks on succeeding generations.

Shafi, M. (1994) stated that "Sustainable Agriculture means maximizing the benefits from agriculture and minimizing the threats from the current high input in agriculture practices.

According to Kuhen, F. (1994), ' Sustainability also in simple refers to a process towards the goal of managing the resource base in a way that does not limits its use by future generation. He also defined, Sustainability is a continuous process towards a never ending goal : the management of the natural resource base and its capacity of regenerating in such a way that its productivity is maintained and increased over time.

According to Mukhopadhyay, S. (1994), Sustainability means the meeting of the needs of the current generation without in any way compromising the projected needs of the future.

Desai, A.P. (1995) explained, "Sustainability", the development of an area should be such that it can support the basic needs of its residents within the framework of the local eco-system. It promotes a conservation of resources, keeping the people to their soil with the management of local resources by residents themselves with the appropriate local technology.

Donald and Donald (1995), defined Sustainable agriculture as ' the farming that meets demands over the indefinite period at economic, environmental and other social costs consistent with rising income. Thus, sustainable agriculture must meet four important criteria: (i) it must produce adequate food of high quality, (ii) be environmentally safe, (iii) protect the resource base, (iv) be profitable.

In (1996), U.K Round table on Sustainable Development suggests that 'Sustainable development is a continuous process - a journey, not a destination. Whereas, Zaibet and Omezzine (1996) defined sustainable agriculture as a production system that can be

maintained over long –run while ensuring profitability productivity and environment quality.

Gomez et al. (1996), "Sustainability is defined by set of requirements that must be met by any watershed, regardless of the wide differences in the agro- ecological situation". It proposes a protocol for measuring sustainability at the watershed level by:

1. defining the requirements for sustainability.
2. selecting the common set of indicators.
3. specifying threshold levels.
4. transforming the indicators into a sustainability index.
5. testing the procedure using a set of data from selected watersheds.

Chopra, K. (1996) explained, The Sustainability of development process is essentially a consequence of the interaction between socio-economic and ecological system. Socio- economic system are faced with constraints or impulses originating from sources such as the carrying capacity, or the waste assimilating capacity of the ecosystems. Thus, what Norgaard (1981) refers to as a 'Co-evolutionary perspective" I viewing these inter- relationships becomes necessary. Sustainability, therefore, implies consistency between socio- systems and eco-system, interpreted as the long run survival of specific types of land use concept of sustainability also implies seeing development as the consequence of such co-evolutionary interactions. Sustainable development is viewed as a kind of robust equilibrium between economic and ecological system.

An Interim Response to the Second Annual Report of Round Table on Sustainable Development was published in August (1997) by

Department of the Environment, Transport and the Regions **(DETR)**. According to this, 'Sustainable development should have 'social objectives as well as environmental and economic goals (Para, 4). It argues that Sustainable development is also about satisfying peoples basic needs, such as access to clean water and giving people the opportunity to achieve their potential through education, information, participation and good health."

Singh, J. (1997), 'According to Oxford Dictionary, "Sustainability" means endurance under perpectual stress. In agriculture, Sustainability refers to endurance of agricultural resource base under conditions of constant pressure. Thus, the sustainability of agriculture may be defined as the maintenance of agriculture resource base in permanent healthy condition and regular development of superior quality and high yielding plants and animals through genetic manipulation so that enough food of good quality continues to flow from it for all times to meet the requirement of the present and future population. According to this, definition, Sustainability have three perspectives :

1. maintenance of agricultural resource base in definite healthy conditions.

2. evolvement of new hybrid plants and cross breed animals for higher yields and quality products.

3. population control.

Chauhan, I.S and Chauhan, A. (1998), says that the ultimate goal of management of natural resources is the achievement of sustainability. The definition of term " Sustainability" than that provided by the official British Columbia motto "Splendour without Diminishment".

Hegde, G.M. (2000), According to him, " Sustainable agriculture is a set of farming practices which can continue to maintain the farm productivity, efficiency and profitability in the long run, without depleting the natural resources and the environment.' For ensuring the sustainability of small farmers, it may be useful to encourage the adaption of indigenous skills, use of internal inputs, preferably from organic sources, least dependence on external inputs, greater imphasis on crop diversity, symbiotic crop rotation production focused on local needs and easy marketability.

According to Gupta, V.S. (2001), the World Development Report 1999/2000, Entering the 21st century defines sustainable development as: Any sustainable development agenda must be concerned with integerational equity – that is that future generations have the same capability to develop as the present generation. A development path is sustainable only if it ensures that the stock of overall capital assets remains constant or increase over time. Environmental sustainability is also connected with the intergenerational equity while the wealthy consume more resources overall, the poor tend to rely more heavily on the directed exploitation of natural resources than the rich.

The goal of sustainable agriculture is to feed the expanding population, while farming in an ecological- sound, regenerative way. Economically viable systems that minimize the purchase of its farm inputs such as pesticides and fertilizers and rely on the renewable resources, form the crux of sustainable agriculture farming methods that emphasize soil building practices (crop residue, animal manures, green manures etc.).

SIGNIFICANCE OF THE STUDY AREA

Human beings have been harnessing the natural resources since they appeared on the earth to meet the basic requirements. The

phenomenal increase in population of both man and animal added with the growing industrialization and urbanization in the past few decades causing further degradation which ultimately affect the survival of mankind.

The dissertation makes an attempt to study the " **Ecological Challenges to Sustainable Agricultural Development: A case study of Ghaziabad District"** at two points of time 1990-91 and 2000-01. The data analysis has been done at block level to know the sustainability of agriculture and environment as well as to know the ecological factors responsible creating problems or challenges facing agriculture.

The significance of study area is to evaluate the sustainable agricultural development in ecological perspective. District is considered as one of the agriculturally developed region of western Uttar Pradesh. The region has also experienced the affect of 'Green Revolution' during that period and used high doses of chemical fertilizers, HYV of seeds, new agricultural technology, pesticides and insecticides, but this brought many environmental problems which affected the agricultural land and the environment simultaneously. Basically land degradation both soil and water has polluted and created problems in the district due to industrialization and urbanization, population pressure on land, deforestation, air pollution, wastes material coming out through factories etc. So, to sustain the agricultural land and its productivity as well as to maintain the ecological balance, it is necessary to study various challenges facing agriculture in both the context, viz. Agricultural development and Environmental degradation.

There is a marked difference between ' Sustainability' and 'Sustainable Agriculture'. In simple ' Sustainability' means to maintain, to uphold and to upkeep the production steadily. Whereas, sustainable agriculture refers to a mode of farming that attempts to

provide long- term sustained yields through use of ecologically sound management technology such as crop diversification, organic soil management and biological pest control.

STUDY REGION

The district Ghaziabad was carved out in the year 1976. This is one of the five districts of Meerut Division Mandal and is one of the most developed agricultural region of western parts of Uttar Pradesh. The district Ghaziabad is a part of the Northern Upper Ganga Plain. The district is bounded by the Ganga river in the east, the Yamuna river in the west, district Meerut and Baghpat in the north and district Gautam Budh Nagar and Bulandshahr in the south. The shape of the district resembles and uprooted tree with its canopy being towards west and trunk towards east touching the Ganga river. The length of the district is more extended towards east to west in comparison to north to south. The length is 72 km long in the east. According to 1991 census, the total geographical area of Ghaziabad district was 1967 sq kms. less than 1 % of the total area of U.P (294416 Sq km).

The entire area of this district is almost plain. Besides the river Ganga and Yamuna the other river includes, Hindon river, Kali nadi, Chhoiya nadi drains in the western and central portion of the district respectively. In these rivers, water flows almost throughout the year. During rainy season, it brings floods and over flow of water to the nearby areas. These rivers which influence the socio –economic conditions of the people of Ghaziabad district.

Administratively, Ghaziabad district is divided into four Tehsils namely Ghaziabad, Hapur, Modinagar and Garhmukteshwar and eight blocks namely Rajapur, Loni, Hapur, Dholana, Garhmukhteshwar, Simbhawali, Bhojpur and Muradnagar. The

blocks falling in each tehsils with number of villages is given in Table No.1.

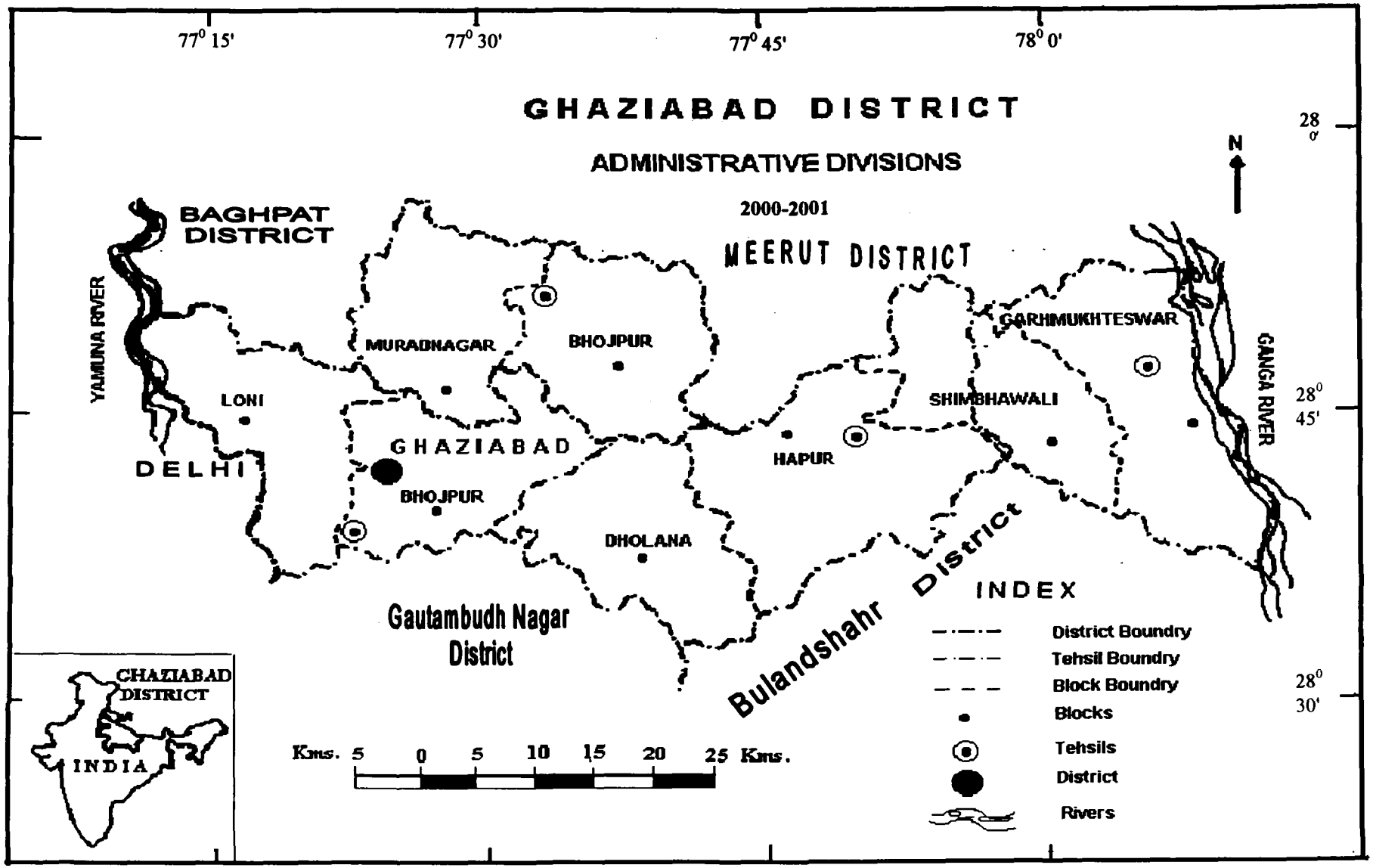
Table No. 1

Administrative Divisions of Ghaziabad District (2000-01)

S. No.	Name of Tehsil	Name of the Blocks	No. of Villages
1	Ghaziabad	1. Rajapur	33
		2. Loni	45
2	Hapur	3. Hapur	99
		4. Dholana	64
3	Garhmukhteshwa	5. Garhmukhteshwar	84
		6. Simbhawali	74
4	Modinagar	7. Bhojpur	57
		8. Muradnagar	60
		TOTAL	**516**

Source : Statistical Office, State Planning Institute, Economic and Statistical Department, Lucknow , Ghaziabad (2000-01)

It is situated on the Delhi Haridwar road and is about 25 km from the National Capital Region (NCR), Delhi. Ghaziabad is the district Headquarter and it is one of the important industrial town of Uttar Pradesh. District includes industries like, Textiles, Electronics material, Engineering, Iron industry etc. Most industries are located along the Meerut road, Bulandshahr road and Kavi nagar industrial areas.


77° 15'
77° 30'
77° 45'
78° 0'
GHAZIABAD DISTRICT
ADMINISTRATIVE DIVISIONS
2000-2001
N
28° 0'
BAGHPAT DISTRICT
MEERUT DISTRICT
YAMUNA RIVER
MURADNAGAR
BHOJPUR
GARHMUKHTESWAR
GANGA RIVER
LONI
SHIMBHAWALI
28° 45'
GHAZIABAD
DELHI
HAPUR
BHOJPUR
DHOLANA
Gautambudh Nagar District
Bulandshahr District
INDEX
District Boundry
Tehsil Boundry
Block Boundry
Blocks
Tehsils
District
Rivers
28° 30'
CHAZIABAD DISTRICT
INDIA
Kms. 5 0 5 10 15 20 25 Kms.

AIMS AND OBJECTIVES:

The aims and objectives of the study are as follows:-

(i) to examine the ecosystem, i.e., natural characteristics in terms of physiographic division of the study area and to evaluate its natural resource potential.

(ii) to examine the impact of developmental processes on the ecological system with special reference to the developments in agriculture.

(iii) to explore the possibilities of evolving suitable strategies for eco- friendly development without disturbing the environment; keeping in view the specific resource base of the region.

(iv) To find out the ecological problems which is associated with the land resources and finally,

(v) The application of the above mentioned objectives for the strategies of sustainable agricultural development.

HYPOTHESIS

(i) Adoption of new agrarian technology is likely to result in the degradation of soil, water and environmental resources in the long run.

(ii) Intensification of agro- pastoral practices is likely to cause deterioration of envrionmental resources of the fragile semi-arid (*Bhangar*) belt.

(iii) Extensive exploitation of forest resources by local people and the private contractors is likely to cause an ecological chain-reaction. This may results in the degradation of the ecosystem particularly the soil and water resources.

(iv) Industrial activity delinked from the territorial distribution of natural resources may lead to break in the natural cycle of production thus adversely disturb the ecosystem.

(v) The increasing quarring activities for economic exploitation of the natural resources and unauthorise occupation of the Delhi Ridge is resulting into extensive degradation of geologically significant landform.

DATA SOURCES AND METHODOLOGY

The secondary data related with the landuse and agriculture has been collected at block level from the years 1990-91 and 2000-01. Most of the data have been collected from various published and unpublished records of Block Development office, District Statistical office, Statistical Hand Book, of the district and Statistical abstract of Uttar Pradesh.

The data related with the land degradation have been collected from Soil Conservation Department, Ghaziabad. The data related to ground water, surface water, air pollution have been collected from Central Pollution Control Board (CPCB), Delhi. The climatic data have been obtained from the Indian Metrological Department (IMD) , East Arjun Nagar, New Delhi. Soil related data and maps have been collected from All India Soil & Landuse Survey, Ministry of Agriculture, Govt. of India, Noida.

The maps concerned with the environmental conditions and environmental degradation are also obtained from the Central Pollution Control Board (CPCB) and their Industrial Zoning Atlas is

procured for these maps. Since the Delhi Metropolitan area (DMA) is very much in the vicinity of the Ghaziabad district, all the climatic data have been taken from Delhi Metropolitan area.

Ghaziabad has been consulted District census Handbook (2001) for latest population data. Ghaziabad District Gazetter has been consulted for highlighting historical background of this district. The other offices such as ADM Planning Tehsildar Sadar, Mandi Samities etc., have been frequently visited during the entire study for all the latest information and data related to the agricultural development of this district.

A number of periodicals and research journals have been consulted which are available in the Seminar Library of the Department of Geography, AMU, Aligarh, M.M.H College research library, Ghaziabad, Lady Ratan Tata Library, D.U School of Economics, New Delhi, D.U. Central library, INSA, New Delhi, JNU, New Delhi, C.C.S University library, Meerut.

The 1:50,000 scale map sheets covering district Ghaziabad have been collected from the Map Sales Office, Survey of India, Janpath, New Delhi for preparing the base maps for various thematic maps of the district.

SATELLITE DATA SOURCE / BASE

Indian Remote Sensing satellite data IRS- IC, LISS-III, False Colour Composite (FCC) with band combination of 4,3, and 2 (R a B). Geo coded sub scane, Path row which corresponds to survey of India toposheet nos. 53 H/5, 6, 9, 10, 13, 14, 53 L/1, 2, acquired on 24th Feb, 1997, have been used to prepare the Landuse and Land cover map of the study area. The satellite imageries are acquired at 11.12 A.m which are fully cloud free. The spatial resolution of LISS- III

Sensor is 23.25 mtrs. The scale of satellite imagery are 1: 50,000 (2cm= 1km). The reduced satellite imageries have been presented in Fig. No. 15 in the Land use / Land Cover map of the study area.

METHODOLOGY

The landuse data of the district on block level for a decades gap i.e. 1990-91 to 2000-01 has been analysed in various ways to study the temporal changes over a period of ten years. To analyse the level of agricultural development of the district various parameters like HYV of seeds , use of improved fertilizers , agricultural equipments and machinary, technological innovations, etc. are studied in greater depth. Various methods and techniques at arriving logical conclusions are used which are commonly used by various researchers.

The change detection in the landuse of two years 1990-91 to 2000-01 have been brought out by calculating simple percentage of both the years and its variation from the base year.

To analyse the level of agricultural development the indicators have been taken from Mohammad, N., in his article " *Agricultural Development and Environmental degradation in Sonipat District, Haryana*". The level of agricultural development has been ascertained at block level taking various indicators. On the basis of data for agricultural development, it has been calculated at block level by taking 9 indicators of agricultural development . The indicators are given below:

X_1 = percentage of net sown area to total area

X_2 = intensity of cropping

X_3 = consumption of fertilizer per hectare

X_4 = percentage of net irrigated area to net sown area

X_5 = number of energized pumpset per 1000 hectare Of net sown area

X_6 = average size of the land holding

X_7 = number of agricultural marketing center per 1000 hectare of net Sown area

X_8 = number of tractors per 1000 hectare of net sown area

X_9 = Average size of foodgrain per hectare of net sown area

The indicators reflect the development which has taken place during last 10 years in agricultural sector. As these indicators are of different nature and character, 'Z' score have been used to standardize the analysis. This has been used to develop the composite score for each set of variables in order to arrive at a general level of agricultural development for the region as a whole. In order to assess overall level of development, First of all, percentage have been calculated of each block and then calculate the mean. After that standard deviation have been calculated and with the help of following formula the 'Z' score has been applied to analyse the level of agricultural development.

$$Z = \frac{X - \bar{X}}{S.D}$$

Z = Standard score

X = Original value of the observation

$\bar{X}$ = Mean for all the values of x

SD = Standard deviation of x

After working out the Z- Score of all the indicators average is taken out for each group of variables in all the three schemes. All the

three sectors are not equally significant nor they contribute to level of agricultural development, each sector has been given the following weightage.

(i)	Agricultural Condition	0.4
(ii)	Agricultural Infrastructure	0.3
(iii)	Agricultural Production	0.3
	Total	1.0

In order to asses overall level of development the group averages have been multiplied with the respective weightage. The resulting figures of all these averages have been added together and divided by 3 which gives composite index of agricultural development for each block.

On the other hand, to asses the level of environmental degradation 7 indicators have been taken at block level for the year 2000-01. These indicators of environmental degradation are also of varied nature and character and they are neither comparable nor they could be aggregated in original form. Indicators taken to analyse the level of environmental degradation are forests area, net sown area, fallow land, soil erosion, water logging, salinity and alkalinity, ground water depletion. To get a comprehensive and composite picture of environmental degradation in each block, a composite Index of environmental degradation (CIED) has been worked out for them by adding the values of individual indicators and dividing it with total number of indicators. Based on this indices of each blocks, the level of environmental degradation has been worked out by grouping them into three categories viz. High, Moderate and Low.

The water pollution sensitivity shows the risks on the environmental degradation from water pollution. The surface water pollution map is prepared was based on the surface water use, the surface water quality and the surface water flow considerations.

METHODOLOGY TO DERIVE LANDUSE FROM SATELLITE DATA

Based upon the image characteristics and other associated parameters, visual image interpretation is done for extracting the spatial information from the satellite imagery. The satellite date in the form of Geo coded FCC were analysed and mapping units were delineated as per the legend developed on the basis of various land use/ land cover/ land cover classes in the imagery. The land use classes are based upon the standard classification adopted by the National Remote Sensing Agency (NRSA). The data products are valuated through logical criteria keeping the physiographic conditions and cultural aspects of the region in sequential form. Limited ground verification is made to verify the doubtful areas. The image characteristics of various landuse landcover classes is presented in the Table No. 2.

Image characteristics / Interpretation Key for Land Use/ Land Cover Map

S.No.	Land Use / Land Cover Category	Colour / Tone	Size	Shape	Texture	Pattern
1	Built up area Town/ City	Dark bluish gray, mixed with scattered reddish tinge	Small to Big	Irregular	Course and mottled	Clustered to scattered, Non Contiguous
	Villages	Light bluish gray, isolated, Connected with road networks	Small to Big	Irregular	Course and mottled	Clustered to scattered, Non Contiguous
2	Agricultural land Crops lands	Bright red to red (moderate)	varying in size	Regular to irregular	Medium to smooth	Contiguous to Non Contiguous
	Fallow Land	Yellow to greenish blue	Small to large	Regular to irregular	Medium to smooth	Contiguous to Non Contiguous
	Agriculture Plantation	Dark reddish brown	Small to medium	Regular shape	smooth	Dispersed and Contiguous
3	Forest/ Jungle	Dark red to red in different tinge	Varying in Size	Irregular Discontinuous	Smooth to medium	Contiguous to Non Contiguous
4	Wasteland Waterlogged	Light to dark bluish black (subject to surface moisture)	Varying in Size	Irregular Discontinuous	Course to mottled	Contiguous dispersed in patches
	Brick Klin	Yellowish white	Smaller Size	Regular shape	Moderate smooth	Contiguous
	Barren / Rocky/ Stony waste	Grayish blue, brownish yellow (subject to varying rock type)	Varying in Size	Irregular and Discontiguous	Course to Course medium	Contiguous and Dispersed
5	Water bodies	Dark black to light black with blusih tinge	Smaller size	Regular shape	Smooth	Contiguous
6	Grass lands	Yellowish white to light brown	Varying in size	Irregular	Course to mottled	Contiguous to non - Contiguous

WORK REVIEW DONE SO FAR

A sustainable agricultural system in India will be such that it will ensure sufficient production to meet the social demand in one hand, on the other hand, the ecosystem must not be disturbed beyond its self ameliorating capacity, so that future generation can also meet their needs.

Agriculture is dynamic and flexible system. Man has manipulated the forces of nature to meet the growing needs, but manipulation and exploitation of natural resources led to serious damages to environment such as soil, groundwater, air, soil fertility, biomass production and recycling, genetic resources of micro organisms, plants and animals. Therefore, many agro- scientists, academicians and research scholars have carried out their studies on different aspects of sustainability for maintaining a suitable environment for the fulfillment of increasing population needs for longer period, particularly future generation.

Joradat (1989), studied the ' *Sustainable landuse in Middle East and North Africa*' and is of the view that harvestable yields of barley grain are achieved in 5 out of ten years, but grazing ensures some contribution to sheep nutrition every year in the north coast of Egypt.

Miyazabi and Ryohei, K. (1990) while doing research on '*Sustainable land use in Japan*' reported that livestock and human manure as well as manure of leaves are widely used in Japan to supplement soil fertility. Whereas, Venkataram, (1990) studied ' *the role of Bio- fertilizers in sustainable agriculture'*. According to him certain micro- organisms like bacteria and blue green algae have ability to use atmospheric nitrogen and take this nutrients to the crop plants.

Donald, M. (1992) in ' *Environmental Assesment for Sustainable Rural Development*' has suggested system approach for assessing the

impact identification, prediction and evaluation. Similarly Sharma, B.L. (1992) in *"Sustainable Agricultural Development"* made an attempt on the problems of agro – ecology. The present study sheds light on the problem areas and their treatment for the new cropping system.

Murton, B.J. (1992) concluded while studying the *"Local knowledge and Sustainable Agricultural Development in India"* that sustainable agricultural development requires on the spot attention involving local knowledge , continuous monitoring and sometimes vigorous action. The policy – makers and researchers should listen and learn from farmers. Whereas Singh, S. (1992) in *"Agricultural Development and Environmental Issues"*, gives a thorough treatment to these problems in his paper in which he highlighted that increase in agricultural production is possible by its horizontal expansion and intensification and both have adverse effect on environment.

May, G. (1994) argues in *"Sustainability and the future"* that the concept of sustainable development is oriented to the future. It is based on extra- polative and normative approaches to the future which contend that we cannot go on as we are and that the desirable and perhaps the only way to survive is via. Sustainability. Similarly Kumar, K. (1996) worked on *"Technology for sustainable agriculture"* and summarized that for sustainable agriculture BNF (Biological N fixation) and IPM (Integerated pest management) INM (Integerated Nutrient management), SWM (Sustainable water management) and PHT (Post- harvest technology) may be adopted.

Khound, H.P. (1996) studied in *"Towards Sustainable Agriculture in the Eastern Himalayan Region"*, to present the agricultural scenario in some of the hill states of the north- east and highlight issues and strategies for further development based on agro-climatic planning.

Husain, M. and Hosain, A. (1997) worked on "*Sustainable agricultural development in Banagladesh*" and concluded that sustainability can be addressed simultaneously through integeration of enterprises and mobilization of farm resources besides being adopting eco- friendly and system based technology. And Chattopadhyay, S. (1997) made a study on "*Designing a sustainable land use pattern- A therotical exercise with examples from Kerela*". He has put the environmental, economic and social filters in final selection of landuse.

Singh, J. (1997) has focused attention on "*The development of Non- agricultural sector in South Asia*". He has discussed about the strategies to be adopted for sustainable agricultural development in view of the existing resource of the south Asian countries. He has stated that the important strategies are the diffusion of Green Revolution is technology and deagriculturalization process. Whereas, Bhattarcharya, G. (1997) studied in "*Impact of Environmental Problems on Regional Sustainability: A case study of Bhal region of the Gulf of Khambhat, Gujrat*" that the backward coastal region of Bhal of the Gulf of Khambhat, Gujrat, characterized by low degree of infrastructure and economic development.

Desai, A. (1997) has attempted "*a theoretical explanation of the concepts and strategies for rural sustainability : A GIS based study in backward region of Gujrat*". She has suggested that a proper long term management of land resources can increase the purchasing power of the Indian farmer and alleviate their poverty. At the same time, Blunden, G. (1997) has tried to asses , "*The sustainability of land based production*". He has taken up the case of pastoral farmers of northland and New Zealand. Two contemporary sets of information have been brought together in order to develop further understanding of pastoral farmers perception of the sustainability of their farming activities.

Singh, S. (1997) has discussed about "*Remote Sensing in Landuse Planning for Sustainable development of Arid Eco- System of Rajasthan*". Proper Landuse Planning based on the physical potentials and limitations of the natural resources for sustainable development of different fragile ecosystems. Such as Qureshi, M.H. et al. (1997) have discussed about "*The livestock Economy as a strategy for Sustainable Rural Development*'". According to him, In a Bismoi village, Integerated agriculture along with development of animal husbandry through pasture development will increase their sustainability in long run.

Kelvin, P. (1997) has developed 13 agri- environmental indicators (AET) for sustainable Agriculture viz. nutrients, pesticides, wateruse, landuse and conservation, soil quality, water quality, green house gases, biodiversity, wild lige abitats, landscape, farm management, farm financial resources and socio- cultural aspect. Whereas Sharma, V.P et al. (1997) in *"Land Degradation : Dimensions, Causes and Consequences – A cases study of Haryana"*, has studied the issues related to land degradation induced by irrigation in the specific context of the situation in Haryana.

Kelvelitz, U. (1998) in *"Strategic Guidelines for Sustainable Ecological Development in Himalaya"* has explained the three pillars of sustainable development, (i) Sustainable management of natural resources (ii) Sustainable development and strengthening of key institution, and (iii) Sustainable increase in income levels. By sustainability it means that in a region, the population is capable of adopting to and resisting the environmentally and socially induced crises.

Sharma, V.K. (2001) in *"Organic farming as an alternative agriculture in India : Problems and Prospectus"*, an attempt was made on the practice of Organic farming. According to him, organic farming is only an alternative which may be acceptable on short term basis

but may be viable on long term basis. Similarly, Jana, M.N and Haque, K.E. (2002) studied in "*Suitability of Groundwater for Agriculture in the Terai Area, Darjling District*" to determine the suitability of groundwater for agricultural used on the basis chemical characteristics.

PLAN OF THE WORK

The present study on " **Ecological challenges to Sustainable Agricultural Development : A case study of Ghaziabad District**" has been organized into six chapters, which are as follows:

Chapter- I deals with the introduction comprises of conceptual framework of Sustainable development and Sustainable Agricultural Development in both agricultural and ecological perspective. A brief outlook of the literature review done so far, sources of data taken from various official departments and published and unpublished books, consisting of secondary data. Principles of methodology including qualitative and quantitative both, hypothesis, aims and objectives of the study and plan of the work.

Chapter- II deals in the general physiographic characteristics of the study area to understand the geographical location, their physiographic, relief and drainage pattern, climatic conditions, Agro-ecological zones, soil characteristics and vegetation.

Chapter- III studies the environmental degradation of the study area at block level. In this studies has been conducted to know the level of environmental degradation at block level. General environmental scenario of ground water potential and use, surface water use and quality, soil degradation and sources of soil degradation has been studied.

Chapter- IV presents a comprehensive study of the major ecological challenges to agriculture and disturbing the ecology by various factors in the study area. It includes problems like land degradation, water pollution (Ground water pollution and surface water pollution), air pollution, soil pollution, forest/ vegetation, use of chemical fertilizers and improper mismanagement of irrigation in the study area.

Chapter- V presents the discussion of agricultural development comprises of (i) Landuse pattern of Ghaziabad district as well at block level, (ii) spatial distribution of landuse pattern through remote sensing technique, (iii) studied the level of agricultural development during 1990-91 and 2000-01 at block level using the ' z-score' model to analyse the agricultural development in the study area. As well as consumption of fertilizer has been analysed at block level during 1990-91 to 2000-01.

Chapter- VI the last chapter presents epitomize work of the study area and it has incorporated many more suggestions and recommendations regarding the sustainable agriculture development and ecology. As well as various strategies to be applied for better results in the study area and on the basis of all the related factors responsible for environmental degradation and sustainable agricultural developments. Conclusions has been drawn in the study area at micro- level.

CHAPTER- II

PHYSIOGRAPHIC CHARACTERISTICS

PHYSIOGRAPHIC CONDITIONS

The entire district is a level plain having low lands known as ***Khadar*** in the east of Yamuna and the west of the Ganga rivers, the area lying inbetween river Ganga and Kali nadi, doab area of the Kali nadi and Hindon river and area lying inbetween Hindon and Yamuna rivers. River Ganga, Yamuna and Hindon are perennial rivers of the district and the Kali nadi is a seasonal river. Throughout the region there is preponderance of local slopes over the regional slope. The nature of deposits probably owes to the crescentic bends of the two master streams, the Ganga and the Yamuna. The lower order division are marked in the form of the flood plain and the inter-fluvial bhangar lands.

The area is dotted with sand dunes and sandy ridges which are mostly concentrated in the eastern part close to the river Ganga and in the western part between river Hindon and Yamuna as seen close to Tila Shajadpur and north of mohannagar. Ravinous tract is developed along the drainage ways and land resources stand degraded close to river Ganga, Yamuna and Hindon. This fertile plain dotted with barren patches of flat lands which are usar lands having kankar pan at shallow depth and having alkaline soil on the surface spread as white sheet. Between Pilkhua and Ghaziabad all along the Hapur-Ghaziabad road, scattered patches of usar land covered with alkaline soil are seen. One such example can be seen near village Masuri. This white reh is being used by the locals for washing clothes. Presence of kankar in the form of lenses and bed is common in the central part of the district that is to the west of Kali nadi. Wide flood

plain of Ganga river is discernible in the east and Yamuna river has also developed a wide flood plain in the west but due to the population explosion almost the entire flood plain stands urbanized due to flood protection works. Wide flood plains and high banks are common features in the course of the Ganga and Yamuna along with silt and clay deposits. The elevation of land surface varies from 220 to 222 m above MSL in the northern district whereas it varies between to 204 – 206m in the southern part, and in the central sector of the district. The general slope of the area is from north to south and the slope varies from 0.9m/ km in the central part, 0.3m/ km in the western part and 0.55m/ km in the eastern part. The physiography in general is plain. There are no hill ranges or hills or hillocks or undulating land in the entire study area.

Geologically, the district belongs to recent period while the main soils sub –order associations are Aquents- Fluvents, Psamments – Fluvents – Aquents and Ochropts – Psamments (Fig no.2.a). Rich domat soil is found normally in the area lying between the Ganga and Hindon rivers. Balui – domat is found in the area lying in between the Hindon and Yamuna rivers. Bhur land is usually found in the khadar tract of Yamuna, Hindon and Ganga rivers. Vast alkaline land is mainly around Bhojpur and Dhaulana blocks of the district. The general characteristics of the area includes the source material, their thickness and its potentiality in terms of agriculture. Most essentially the area constitutes an alluvial trough made up of unconsolidated sediments chiefly boulder, sand clay and gravel with their inter calcatious. They are highly porous, permeable and considered to be the most extensive soil cover. Geologically, the alluvial deposits can be classified as ***bhangar*** [older deposits] occupying the higher ground and not flooded by the rivers during the rains and ***Khadar*** [newer deposits] occupying the lower ground. The level of bhangar generally varies from 5 to 6m above the highest point and 15 to 21m. above the lowest level of this river Ganga.

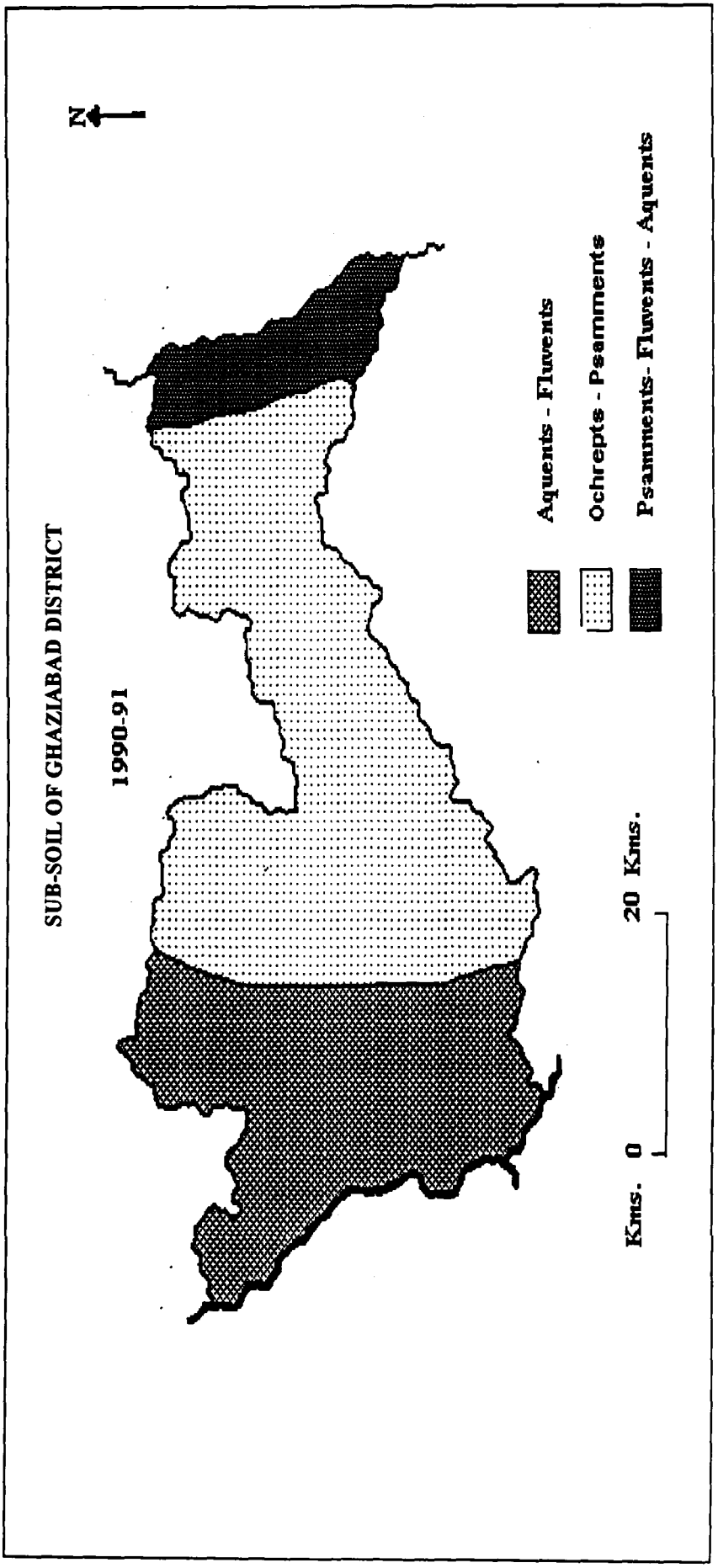

SUB-SOIL OF GHAZIABAD DISTRICT
1990-91
N
Aquents - Fluvents
Ochrepts - Psamments
Psamments- Fluvents - Aquents
Kms. 0
20 Kms.

FIG. 2. a

It contains carbonate of lime in the form of nodules called kankar and is characterized by patches of saline and alkaline efforescene which is the result of gentle slope of the land and the composition of the alluvium. The khadar or the newer deposits occupies relatively a lower level and is liable to inundation at the time of floods. The Ganga deposits are principally of mud and floods in the Ganga proves useful to the cultivation in the lowlands , as it adds fertile silt to it.

On the basis of Geology, soil, climate, topography and natural vegetation the study area is divided into following five sub- micro-regions :

1. Yamuna Khadar
2. Hindon Plain
3. Hapur Plain
4. Garhmukhteshwar Bhur tract
5. Ganga Khadar

YAMUNA KHADAR

In Ghaziabad tehsil, it is delimited by watershed line of the Hindon and Yamuna whereas in Dadri tehsil Hindon river marks its eastern boundry. Small depressions, dead arms of the river, meanders are the main topographical features. Southern part of the plain is flood affected because of the confluence of Hindon with the Yamuna. This is a low lying area but level and fertile. Due to topographical limitations canal network is absent in this tract. Geologically, the region belongs to alluvium, Dun gravels (recent) in Fig No. 2.b, while the main soil sub-order association is Aquents-Fluvents.

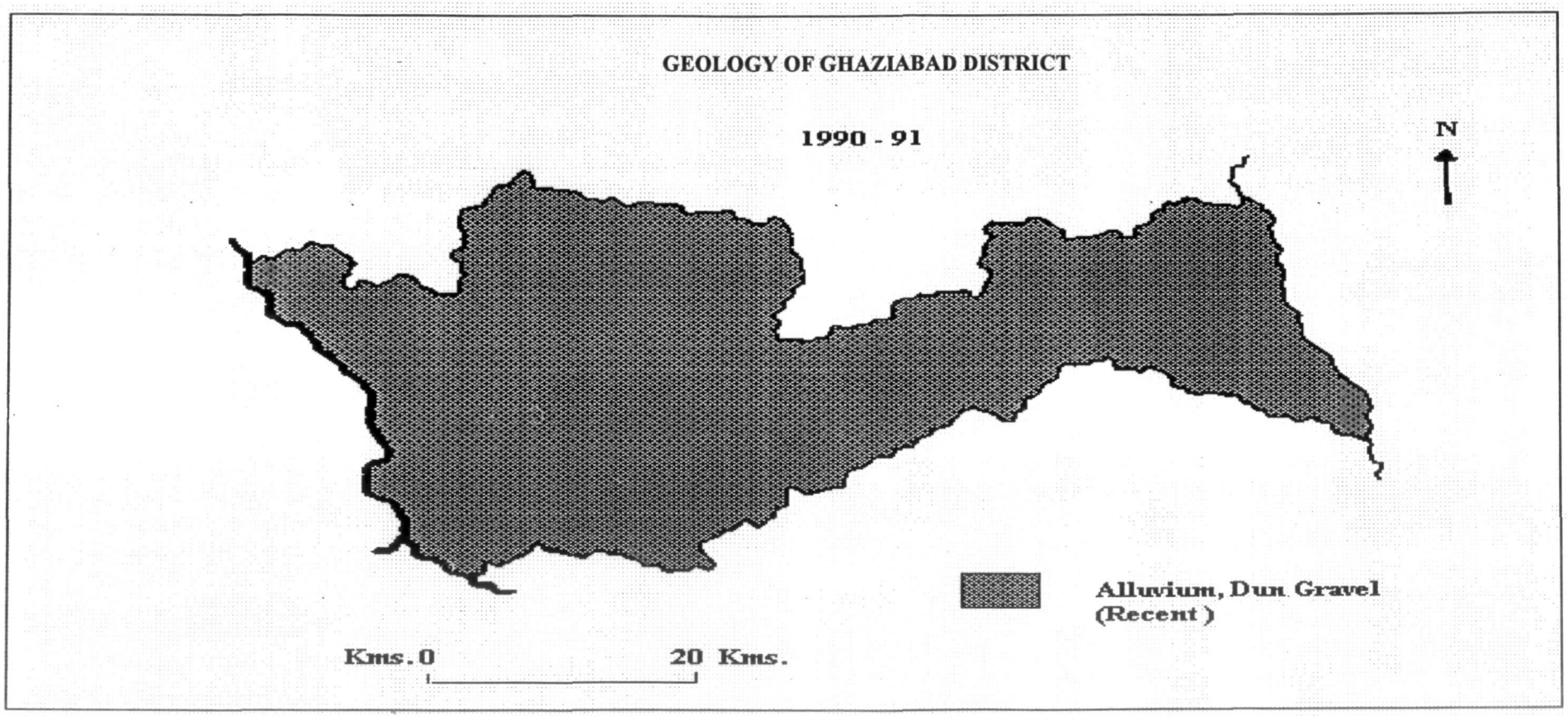

GEOLOGY OF GHAZIABAD DISTRICT
1990 - 91
N
Alluvium, Dun Gravel
(Recent)
Kms. 0
20 Kms.

FIG. 2 . b

HINDON PLAIN

Hindon plain which is triangular in shape lies in Ghaziabad tehsil and is delimited by watershed line of the Hindon in the east and the Yamuna in the west. The Hindon is the artery of this belt which drains its central part. Soil erosion is a common feature along the Hindon river. Its slope is towards south. It is a level and fertile plain which is irrigated by Tikri Eastern Yamuna Canal. Geologically, the region belongs to alluvium, Dun gravel (Recent), while the main soil sub- order association is Aquents- Fluvents. Transport facility are extensively developed in this region.

HAPUR PLAIN

This plain is slightly lower in the central part that its eastern and western sides but the general slope is towards south. The river Kali along with chhoiya and Kharuali, collect the water of the region and flow parallel to Ganga. There are patches of bhur or sand dunes on its eastern part. The Ganga canal system irrigate this plain which is famous for agricultural production. This tract is one of the best agricultural belt of the state. Geologically, the region belongs to alluvium, Dun gravels (Recent) while the main soil sub order association is Orchrepts- Psamments.

GARHMUKHTESHWAR BHUR TRACT:

It is situated parallel to Ganga Khadar in Garhmukteshwar tehsil. Patches of Bhur are spread over in this belt. Due to pressure of population and technological development the Bhur patches have been reclaimed and have been brought under agriculture. The slope is gentle towards south. It is separated by natural levee from khadar. The soils of this the region belongs to alluvium, Dun gravels (Recent),

while the main soil sub –order association is Ochrepts- Psamments- Fluvents- Aquents. This tract is fertile and developed in terms of agriculture, irrigation and transport.

GANGA KHADAR

This is narrow belt extending north- south along the Ganga river. Its western limit is marked by the natural levee. The area between the levee and Ganga river is subject to inundation every year. There are number of depression dead arms of the river and shallow ravines. The soils of this regions belongs to alluvium, Dun gravels (Recent), while the main soil sub- order association is Psamments- Fluvents- Aquents. There are grass and shrubs of different height in the entire tract, Due to physiographic limitation infrastructure is at primitive stage.

CLIMATIC CONDITIONS AND RAINFALL

Climate is one of the main genetic factors in the formation of relief (topography) and soil. Climate largely determines the dominance of natural vegetation in any given area. Interaction between climate, relief and soils are particularly important for land use (Vink, 1975) and specifically for cropland occupancies, crop productivities and levels of agricultural development.

Climate can affect the choice of a farming system either indirectly through its influence on soil formation, or directly through such factors as the length of the growing season, the occurrence of frost and the availability of water for crop growth (Shirlaw, 1971). Temperature is of great importance for determining the growing season of the crops and the intensity of photosynthesis process, and responsible for the formation of carbohydrates, quantity in foodgrain

crops, hence affecting their productivity level per hectare. Rainfall input is the primary ecological parameter that profoundly influence crop growth and production.

The district is endowed with typical topographical climate with extremes in summer as well as in winter season. The average weather conditions emerging out of the combined effect of the various elements lead to the recognition of four well marked seasons, i.e., the Hot Summer, the Wet Summer, the pre Winter transition and the Winter. The gradual rise of temperature which starts from February, becomes more rapid increasing by 5°C by March and continues till May/ June (maximum temp. 40°C). The scorching effects of Loo (the hot and dry Westerlies) are aggravated due to the lower relative humidity (below 40°C). Since this district is very much in the vicinity of Delhi territory, its climatic conditions are very similar to Delhi. In summer it is too hot and in winter it is too cold. The climate of the area is semi- arid and characterized by monsoon season for about 3 months. The rainy season commences in the later half of June at different dates which are too uncertain to be predicted. It brings relief to the people by lowering down the temperature gradually which range between 30° and 40°C during June to October. The relative humidity remains fluctuating between 70% throughout the rainy season, except for June when it averages below 50%. The mean annual precipitation of Ghaziabad district and adjoining areas is 945 mm. Monsoon enters at the end of June in this district. In 1999, about 732 mm rainfall occurs in this district. The average temperature is lowest in January (below 20°C). The mean annual, mean summer and mean winter temperature are 22.6°C, 29. 9° C and 15.6° C respectively.

District Ghaziabad has no meterological observatory station . To review the climatological conditions prevailing over the district, observations recorded at Meerut (in the north) and New Delhi (located in the west) have been considered in this area.

Climatological data recorded at Meerut, U.P.

S.No.	Months	Air Temperature °C		Monthly rainfall (mm)	Relative humidity %
		Temperature Daily Minimum °C	Temperature Daily Maximum °C		
1.	January	21.6	6.8	24.6	79
2.	February	24.4	9.2	18.5	70
3.	March	30.1	14.1	10.3	59
4.	April	36.3	19.9	5.1	42
5.	May	39.7	24.1	15.0	41
6.	June	39.2	26.5	54.0	58
7.	July	34.2	25.7	248.0	80
8.	August	32.7	25.0	332.2	84
9.	September	33.6	23.4	138.9	77
10.	October	32.8	18.0	42.8	68
11.	November	28.6	11.4	3.1	67
12.	December	23.6	7.4	8.5	75
Annual		34.4	17.6	901.0	67
No. of years		30	25	30	30

Source: Climatological table (Based on the observation 1951-1980), IMA, Delhi.

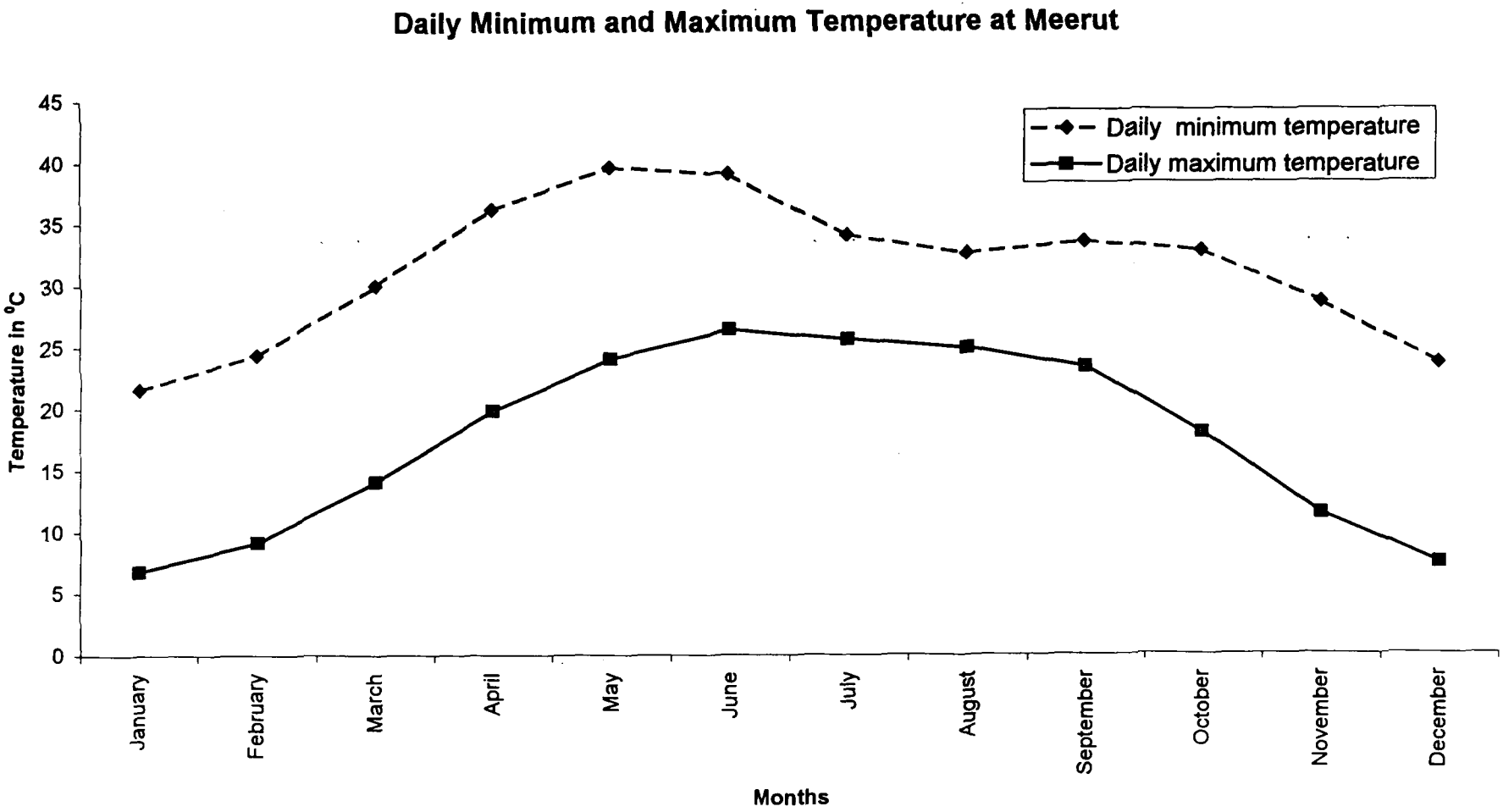

Daily Minimum and Maximum Temperature at Meerut
Daily minimum temperature
Daily maximum temperature
Temperature in °C
45
40
35
30
25
20
15
10
5
0
January
February
March
April
May
June
July
August
September
October
November
December
Months

Fig. 4.a

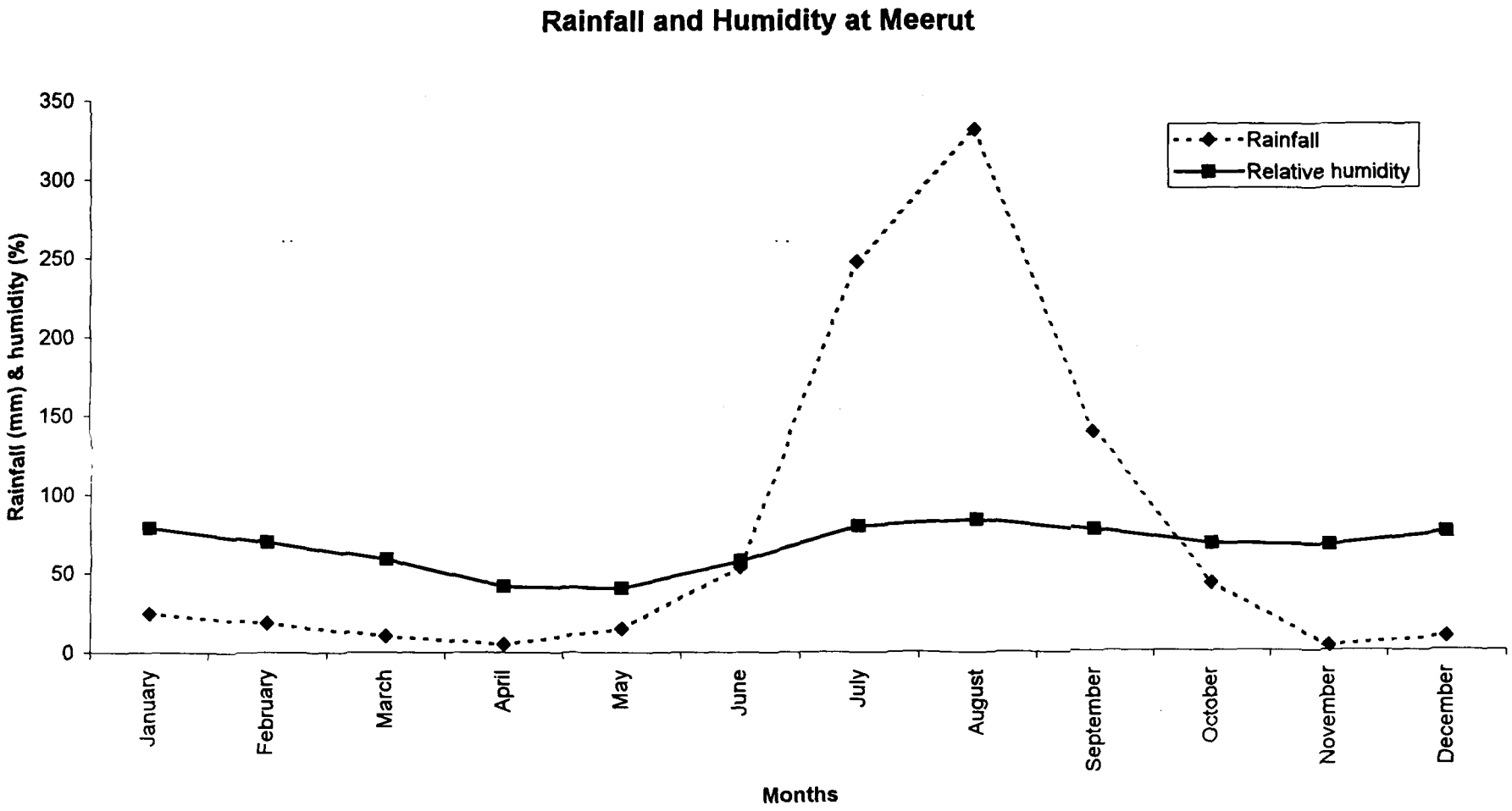

Rainfall and Humidity at Meerut
Rainfall
Relative humidity
Rainfall (mm) & humidity (%)
350
300
250
200
150
100
50
0
January
February
March
April
May
June
July
August
September
October
November
December
Months

Fig. 4.b

Table No. 3 shows the climatological conditions of Meerut District based on the observation of 1951-1980 (30 years) taken from the Indian Meterological Department (IMD), New Delhi. It shows Daily minimum temperature, Daily maximum temperature, Rainfall and Relative humidity of last 30 years. Maximum rainfall is observed during July, August and September whereas, relative humidity (%) is maximum is August (84%) and minimum in May (41%). On the other hand, maximum daily temperature is highest in June (26.5°C) and low in January (6.8°C) whereas minimum daily temperature is highest in May (32.9°C) and low in January (21.6°C). Annual rainfall in Meerut district recorded as 901.0 mm for last 30 years.

DRAINAGE PATTERN

The line of natural drainage in the district is from north to south. The District is drained by three major river systems and their tributries. The main drainage is carried by river Yamuna and river Ganga forming the western and eastern boundary and by river Hindon. Hindon river can be described as the main drainage system of the area. It rises from the Shiwaliks in the northern part of the district of Sarahanpur. Near the village it is joined by the west of Kali nadi, which is a seasonal stream, but attains considerable proportion during the wet monsoon months. Kali nadi is a seasonal river mostly carrying effluents of industrial and domestic nature. Dasna, Kharauli, Quadrabad and Chhoiya are small rivulets which are owing to population pressure, carrying sewage and industrial effluents. The canal system in the District is very extensive and the network of distributaries covers the entire District. The main canals are eastern Yamuna canal and upper Ganga canal and Anupshar branch of upper Ganga canal dividing the District into four parts. Madhya Ganga canal is meant for taking excessive flood water during monsoon season. The area lying between upper Ganga canal and Anupshar

branch of upper Ganga canal is shedding into river Kali. The area west of river Hindon is shedding into river Yamuna and the area east of Anupshar branch of upper Ganga canal is shedding into river Ganga. River Hindon and river Kali shedding into river Yamuna which itself merges into river Ganga [Fig No. 3].

On the basis of relief and drainage the area can be divided into following divisions:

1. The submontane tract
2. The Hindon- Yamuna Interfluve
3. The Kali- Ganga Interfluve
4. The Hindon – Kali Interfluve
5. The Khadar

The **submontane tract** locally called as *Ghar* which corresponds to the bhabar of the eastern Uttar Pradesh. Numerous seasonal streams like Kali nadi, Chhoiya nadi intersect the tract of varying width. The streams of the east and central parts flow into the Ganga, while those of the west join the Yamuna river. The eastern part of the tract consists of a series of broken spurs and plateau which sink abruptly in the plain.

The Yamuna – Hindon interfluve is extensively irrigated by the distributries of the eastern Yamuna and Upper Ganga canals. The water table varies between 25 and 35 feet.

The Kali- Ganga interfluve tract stretch between the Ganga and the Kali nadi which includes the Anupshahr branch. The notable feature of this zone is the occurrence of sandy undulations locally called as *Ghur.*

The Hindon – Kali interfluve is relatively a lowlying illdrained area. The distinguish feature of the area is the lack of drainage. The soil varies from clay to sandy clay in the relatively elevated parts and

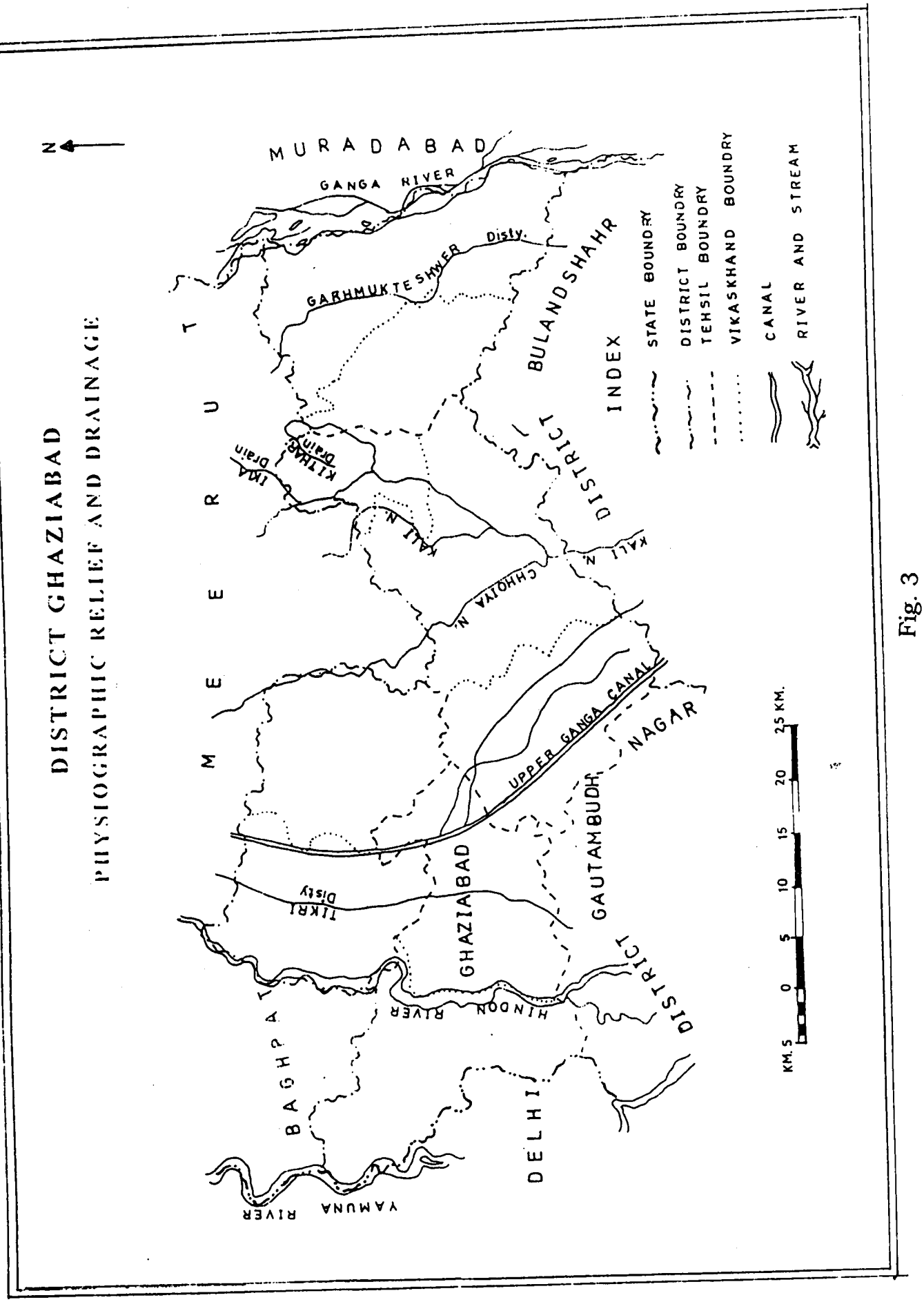

DISTRICT GHAZIABAD
PHYSIOGRAPHIC RELIEF AND DRAINAGE
N
MURADABAD
GANGA RIVER
GARHMUKTESHWER
Distv.
BULANDSHAHR
DISTRICT
INDEX
STATE BOUNDRY
DISTRICT BOUNDRY
TEHSIL BOUNDRY
VIKASKHAND BOUNDRY
CANAL
RIVER AND STREAM
KALI N.
CHHOIYA N.
UPPER GANGA CANAL
GAUTAMBUDH NAGAR
GHAZIABAD
TIKRI
Distv
HINDON RIVER
DISTRICT
DELHI
BAGHPAT
YAMUNA RIVER
KM. 5 0 5 10 15 20 25 KM.

Fig. 3

clay to stiff clay in the depressions. The formation of Alkaline, usar soil, arising form the bad drainage is another characteristic of the area. Water table varies between 15 and 30 feet.

The *Khadar* tract is of varying width along the rivers Ganga, Yamuna and Hindon. The soil of the Khadar varies from pure sand along the river banks to silty and silty clay in the valley of the rivers. The soil, however, immature. The colour varies from light to ash gray and the texture is sandy and silty loam. The water table is very high and during monsoon it remain virtually on the surface itself. The nearness of the ground water level brings about wide spread salt afflorescence. On the surface specially during the summer months when the salt comes up with capillary rise of sub- soil water and its subsequent evaporation (Agarwal, R.P., 1952). The drainage is imperfect and there is no natural flow of ground water either laterally or downward because the water table is within a few feet of the surface. Another outstanding characteristics of the Khadar is its great dependence on river action. The surface of the *Ganga Khadar* is characterized by the presence of swamps and ox- bow lake.

SOIL CHARACTERISTICS

Bhangar corresponds to the age of Pleintocene and occupies the higher ground. The absence of gravels, the presence of fine sediments and the light colour are remarkable features of the *Khadar* soil (Krishanan, M.S, 1956).

The concept of soil quality as assessed by biophysical and agro-ecological parameters is central to sustainable agriculture. To evaluate the land quality, Larson and Pierce (1991) suggested that soil texture, structure , strength, plant available water capacity (PAWC) and maximum rooting depth should be used as physical indicators of soil quality. The US Soil Conservation Service (SCS) has proposed

several physical indicators of soil quality such as infiltration, soil texture, aggregation, soil structure, bulk density, plant root development, drainage, permeability, water retention aeration, available water capacity, heat transfer, crusting, depth to restrictive layers, surface roughness and soil depth (Karlen and stott, 1994). The international Conference on the assessment and monitoring of soil quality has also suggested infiltration, available water holding capacity and soil depth as the first order of soil physical properties effecting soil quality (Papendick, 1991). Doran and Parkin (1994) and Pieri et. al. (1996) have proposed soil physical, chemical and biological characteristics to be included in the basic soil or land quality indicator for sustainable agriculture.

In this region of almost uniform topography , the soil are by and large, homogenous. The alluvial soils with the variants, the Usar and Bhur, depending on the drainage conditions, mechanical and chemical constituents and the climatic characteristics are observed in different parts. The two common types ***KHADAR*** and the ***BHANGAR*** with different local names. In regards to the geological depositions of the plain no marked stages of deposition occur. The occurance of nodules locally known as *Kankar*, which found at various depths is a significant characteristic feature of these soils.

According to Wadia, the alluvium depositas are as follows:

a) the newer alluvium known as *Khadar*; and

b) the older alluvium known as *Bhangar*

There is a lack of scientific data on the soils of Ghaziabad district. The oldest sources of available information are the settlement reports and District Gazetters. Both of which gives a textural classification of soils arrived at by empirical methods for revenue assessment purposed. Therefore, soil analysis data are not available of Ghaziabad district

KHADAR SOIL

The khaddar soils, relatively rich in plant nutrients, occupy the narrow frequent siltation tracts in the flood plains of the rivers. Neutral to alkaline in reaction (pH 6-8), these are deficient in organic materials specially phosphorous and are sandy to loamy in texture. Locally, as observed by Agarwal and Mehrotra, the Ganga Khadar soils have immature profiles with sandy to silty loam texture, lack of concretion, fair proportion of lime and other soluble salts and are alkaline in reaction (pH 8) with imperfect drainage, while the Yamuna Khadar soils have sub- mature profile with predominance of clay and concretion and very high lime and other soluble salt contents under the poor drainage condition. Fertility is revived owing to frequent siltation. Agriculture in this area is precaurious due to water logging and floods.

BHANGAR SOIL

The *Bhangar* soil varies from grey- brown to dark brown in colour. The B*hangar* soil are more extensive in areal spread, occupying the interfluvial zones. In general, the soluble salts and lime are low and show neutral to slightly acidic reaction except pH 6-7.5 in the low lying areas prone to water- logging. Illuviation is a common characteristic everywhere. In the proximity of Ganga there are loamy to sandy loam in texture while near the Yamuna the silt content decreases giving sandy to sandy loam texture possibly due to the excessive drainage. The *Bhangar* soil is sandy to gravelly, highy porous and aerated, and has lower moisture- retaining capacity.

DARK LOAM (Misan)

The land between the streams of the submontane tract (Ghar) consist of dark loamy soil. Grass and shrubs mostly cover the thick layer of the soil resting on a substratum of stones and boulders. In many parts, the underneath structure has been exposed by the erosive action of these torrents.

SANDY LOAM (Raunsli)

In the Ganga- Kali interfluve the dominant soil is sandy laom. The surface soil is yellow to brown in colour, with a sub- soil, which is brownish yellow. The sub- soil is locally known as *Sankrail.* Owing to the course and light texture of the soil, its water retaining capacity is low, but the irrigation facilities by the Upper Ganga Canal and tube wells have made it capable of producing good crops of sugarcane in the Kharif and Wheat in the rabi season.

CLAYEY LOAM (Seota)

The well drained Hindon- Yamuna interfluve is covered by clayey loam soil. As compared to *Raunsli* soil, it is rich in clay and its water retaining capacity is high. The surface soil is brown to dark brown in colour, while dark gray in lower horizon. Salt contents in this soil are low. The clayey loam tract is extensively irrigated by Upper Ganga canal and tube wells.

CLAYEY SOIL (Chikkan, Dakar)

The lying areas of clayey soil in the years of low rainfall weeds, viz. kans, phoos and Kasair flourish and render the ploughing of land difficult.

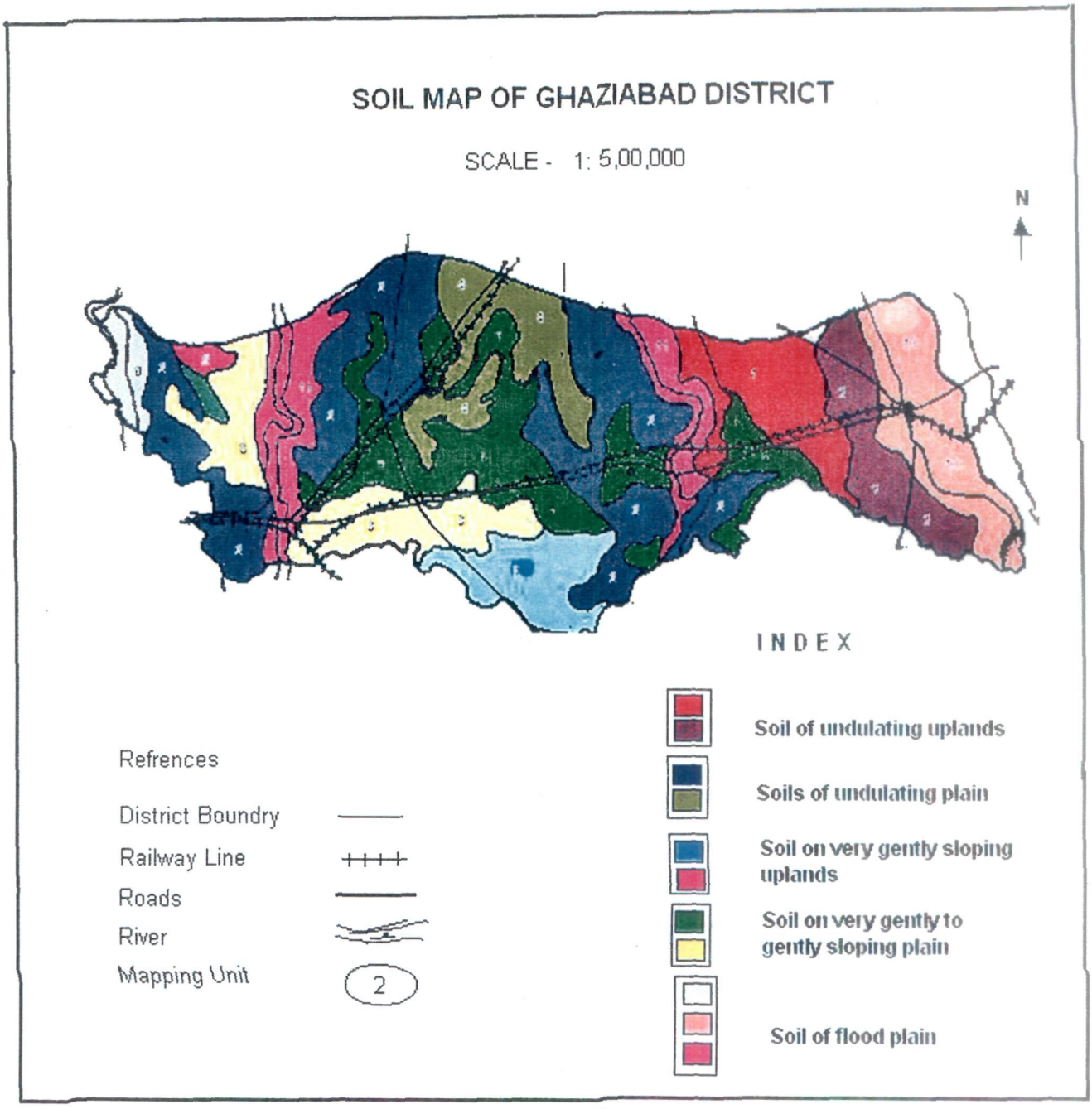

SOIL MAP OF GHAZIABAD DISTRICT
SCALE - 1: 5,00,000
N
INDEX
Soil of undulating uplands
Soils of undulating plain
Soil on very gently sloping uplands
Soil on very gently to gently sloping plain
Soil of flood plain
Refrences
District Boundry
Railway Line
Roads
River
Mapping Unit
2

Fig-5

Fig. No. 5 shows a soil map of Ghaziabad District which has been categorised into 11 categories to represent the soil texture of the study area. They are:

Soil of undulating uplands

1. Deep, Moderately well drained, fine loamy soils on gently slopes with loamy.

2. Surface, moderate to slight erosion associated with the fine loamy surface soil.

Soils on undulating plain

3. Deep, well drained, fine montomorillonitic soils on gently slopes with loamy.

4. Surface, erosion associated with the fine loamy soils and moderate erosion.

Soil on very gently sloping uplands

5. Deep, well drained, fine soils on gently slopes with loamy surface and slight.

6. Erosion associated with deep fine loamy soils and moderate erosion.

Soil on very gently to gently sloping plain

7. Deep, Moderately well drained, fine loamy soils on gently slopes with loamy.

8. Surface, moderate to slight erosion associated with well drained slightly calcaeous soils.

Soil of flood plain

9. Deep, Moderately well drained, fine loamy calcareous soils on very gently slopes.

10. With loamy surface, moderate to slight erosion associated with well drained fine.

11. Loamy surface.

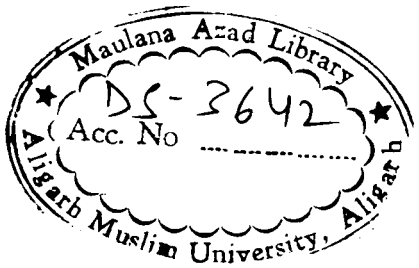
AGRO –ECOLOGICAL ZONES

Present Concept

Agro- climate zone is a land unit in terms of major bioclimate and length of growing period and which is climatically suitable for certain range of crop cultivators (FAO, 1983). In the words of Senso (FAO, 1983), " An ecological region is an area of the earth's surface characterized by distinct ecological responses to macro climate as expressed by soil, vegetation, fauna and aquatic system".

Thus, the agro- ecological region is a land unit carved out of agro- climatic region when superimposed on landforms and kind of soils and soil- site characteristics that act as modifiers to climate and length of growing period (Sehgal, J. 1990).

In short, the major ecological regions are the areas having more or less uniforms in respect of soils, climate, physiography, natural vegetation et., found in a entity which differs from other region. In other words, the agro ecological region bears an Homogenous entity in terms of agro - ecological condition.



Earlier Approaches:

Several attempts were made to regionalize Agro- Climatic/ Ago-Ecological Zones in India. Cartyer (1954) divided India into 6 climatic regions ranging from arid to per humid based on the criteria of Thornwaite system of climate classification. Thornwaite and Mather (1955) proposed a rational classification in which ' water deficit' and ' water surplus' were introduced. Higgins and Kassam (1981) while working in FAO adopted the growing period with climate to delineate agro- ecological zone approach to determine land potential. According to them, growing period (GP) starts when precipitation (P) exceeds 0.5 potential evapotranspiration (PET) and ends eith utilization of 100mm, of stored soil moisture ones P falls below PET. The GP period in days were calculated for each observations site, plotted and isolines drawn at an interval of 30 days. Bhattacharya, et al. (1982) correlated the bio- climatic types and the Growing Period (GP) less than 90 and semi- arid region corresponds to 90- 150 days to GP. The sub- humid zone, more or less, correlates with the region having GP between 150-210 days. FAO (1983) delineated agro- climatic zones by superimposing isolines of growing period at 30 days interval on to major climates. The growing period zones were calculated on the basis of mean daily temperature (T) precipitation (P) and potential evapotranspiration(PET). Sehgal et al. (1987) delineated the different moisture regimes in north west India.

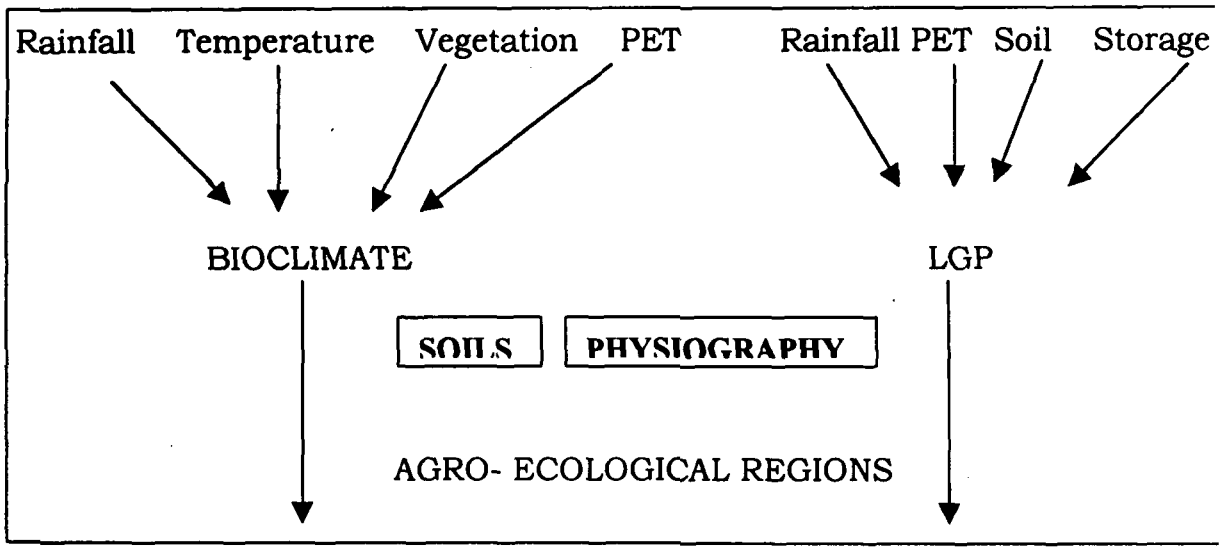


Fig. No. 6 Agro-ecological zones

VEGETATION

The district lies in the sub-tropical division of deciduous type of vegetation does not have expenses of natural forest. Whatever, forest occur are in patches in the low land [Khadar] around the Ganga and lower and Upper Ganga Canals. Thick vegetation is found along the canals and natural levees of river Ganga and Yamuna, as well as on plantation along the road. In the year 1998-99 total 2470 hectare area is reported under natural vegetation. Mostly vegetative area is found in Garhmukteshwar block i.e. 989 hectares. In Bhojpur block 727 hectare and in Muradnagar block it is 277 hectare under vegetative area. Economically, vegetation is not having any value in this district because it is an industrialized are due to very near to NCR of Delhi and very much influenced by the urban encroachment. Small scale industries are shifted to this district and the agricultural land has been transferred into either residential area or an industrial area. Some common names of trees, shrubs and grasses are :

1. Trees :- Neem, Mango, Badni, Ber, Pals, Dhak, Kadam, Jamun, Pipal, Imli, Shisham.

2. Shurbs :- Karil, Hins, Bansi, Lantana, Hina, panwar, madar, karaunda and mako.

3. Weeds & Grasses :- Dub, Dab, Munjakans, Patera

4. Ornamental trees :- Kachnar, Gulmohar, Ashok, Amaltas, Eucaliptus and Chameli.

CHAPTER - III

ENVIRONMENTAL DEGRADATION

Environmental degradation is a form of environmental change which leads to lower level of production , degradation of agricultural land, shortage of fire wood and fodder, threats to flora and fauna and biological diversity, change in micro- environment etc. Environmental degradation in recent times is the result of continuous growth of population and consequent over exploitation of natural resources for higher standard of living. Pollution of water, air, global warming, depletion of ozone layer, famines, droughts, floods, acid rain, green house effect, scarcity of fuel, firewood, food and fodder, soil erosion etc. are the ultimate results of environmental degradation. Water and wind erosion are very much damaging the limited natural resources. Wide spread problem of declining soil productivity due to land degradation caused by water logging, floods, salinity, alkalinity etc. is on increase. The water bodies suffer from over enrichment of discharge from industries, drainage from agricultural and domestic chemicals and wastes. Air and noise pollution are also degrading the environmental quality because of ever increasing industrialization and urbanization.

Land is an important natural resource, which affect both humanity as well as for maintaining ecosystem. In India, it is estimated that out of 329 million hectare of geographical area, 175 million hectare is suffering from various kind of degradation. According to National Bureau of Soil Survey and Landuse Planning [1994], 57 percent of the total geographical area of the country is suffering from various degradation hazards of which a dominant fraction [45 percent] is under water erosion and the rest 12 percent is suffering from wind erosion, chemical deterioration [loss of nutrient and salinization] and physical deterioration [water logging]. The total

are affected comes down to 151 million hectare representing 45.9 percent of the total geographical area of the country. It is important to note that land degradation is an ecological disaster born out of abuse and mismanagement of land resources.

As the district is one the most agriculturally developed region of the western U.P, it has almost all the problems of environmental degradation specially land degradation, although of varying level and intensity. The reason behind this is that the area was also affected by the ' Green Revolution' using HYV varieties of seeds, use of chemical fertilizers, better irrigation facilities availed etc. which increased the food production for self sufficiency. But it become a major threat to ecology when the environmental balance has been disturbed due to depletion of forest, soil erosion, waterlogging, alkalinity and salinity, ground water depletion, soil degradation, air pollution and growth of industrialization and urbanization during this decade.

In this chapter, present environmental degradation of Ghaziabad district has been explained at block level in different ecological parameters such as Land degradation, Ground water potential, Surface water quality, Soil degradation, sources of soil degradation which has become a major challenges facing agriculture.

LAND DEGRADATION PROCESS

Land degradation is a dynamic process and its measurement is not rather easy. In simple, it may be defined as the loss of utility or potential utility. According to Blackie and Brookfield [1987], land is degraded when ... it suffers a loss of intrinsic qualities or a decline in its capabilities... [It]... is therefore best viewed not as a one way street but as result of forces, or the product of an equation, in which both human and natural forces find a place; that equation being:

Net degradation

[natural degradation process + human interference] =[Natural reproduction + restorative management]

Land degradation process is, therefore, a composite term describing the aggregate diminution of the productive potential of land, including its major used [rainfed area, irrigated, range land, forestry] it farming system [eg. small holder subsistence] and its value as an economic resources. Land degradation in national perspective is shown on Table No. 4.

Table 4

Status of Land Degradation in India

S.No.	Degraded Land	Area/m ha	%
1	Total Geographical Area	329	100.00
2	Total Problem Area	175	58.20
3	Area subject to water & wind erosion	150	45.60
4	Water logged Area	6.0	1.80
5	Alkali soils	2.5	0.75
6	Saline soils including coastal saline	5.5	1.57
7	Ravines and Gullies	4.00	1.22
8	Area subject to shifting cultivation	4.30	1.31
9	Ravinous lands and Torrents	2.70	0.85

Source: National Commission on Agriculture.

Various workers and agencies have emphasized the seriousness of the problem and done enormous efforts to define, identify and map the different land degradation types prevailing worldwide. In India, wasteland mapping under the auspices of National Wasteland Development Board [NWDB] has been carried out by several organization. Thirteen categories of wastelands have been included baring cultivated lands. N.R.S.A have published a 1:1*m scale map of wastelands of the entire country. Studies on salt affected soils and their monitoring using landsat TM and IRS – IA data has been carried out by Punjab Remote Sensing center. Land degradation problems in the arid regions of Rajasthan are being studies by CAZRI adopting well defined criteria fixed for the region.

Survey of ravinous areas in Rajasthan was carried out by AISLUS in late seventies and reclamability criteria was developed [Bali & Karale, 1977]. Dhruvnarayan and Rambabu [1983], have reported soil loss in India @ 16.35 t/ha/year. Prasad, et. al [1981] estimated 181 t/ ha. Soil loss of Shilong plateau due to defective farming system. Gupta (1975) have reported that the first three rivers of the world carrying maximum sediments are in India. The sediment rate in Himalayan region [Indus, Ganga, and Bhramaputra] varies from 6 to 8 ha m 100 sq. km/ year. In addition, Stray examples of land degradation mapping through remote sensing techniques have been reported by Govindrajan and Motappa (1963), Kamphrost and Iyer (1973), Hilwig and Karale [1973], Dwivedi and Deka [1990], Kushwaha [1990], Sharma and Hargawa [1987], Saini and Das [1996].

All these attempts vary widely with the type , scale approach, base maps and intensity of mapping of degraded lands. Thus, it is not easy to estimate the actual rate and extent of various types of environmental degradation in India.

LEVEL OF ENVIRONMENTAL DEGRADATION

For showing the level of Environmental Degradation 7 indicators has been taken which is showing a clear picture of the Ghaziabad district that how much degradation is there in each blocks in the year 2000-01.

The decline in forest area/ cover is more in Muradnagar [0.10 %] because most of the land has been converted into commercial purposed, build up area and for industrial expansion. Moreover, the forests has been cutting for a long time for fodder and fuel for the people as well as expansion of agricultural land. The net sown area has declined to 0.69 percent on an average. The maximum loss is in Loni [2.36 %] followed by Shimbhawali [1.14 %] and Hapur [0.91 %], whereas lesser loss is recorded in Bhojpur [0.21 %], Muradnagar [0.25 %], Rajapur [0.34 %], Dholana [0.25 %] and almost neglible in Garhmukteshwar block [0.06 %].

As the agricultural land has been deteriorated due to higher induction of agricultural technology especially chemical fertilizer, HYV of seeds, irrigation water, farm implements, the cultivators have no option except leaving the land fallow for some time depending upon the degree of deterioration. Hence, the area under fallow land is ranges between 1.44 percent [Loni block] to 0.12 percent [Rajapur block], although the district average is 0.82 percent. Soil erosion is a basic problem in an agriculturally developed region due to excessive cultivation which makes the soil loose and more susceptable to erosion. The percentage increase in soil erosion ranges from 1.66 percent [Hapur block] to 0.39 percent [Rajapur block]. Whereas, other blocks of Ghaziabad district includes high soil erosion in Loni [1.19 %], Dholana [1.01 %] and Shimbhawali [1.12 %]. On an average the district having 0.92 percent soil erosion in 2000-01.

The excessive doses of irrigation, mismanagement of flow of water in the canals have led to the massive underground percolation of water. Consequently water table has come up near the surface leading to low capacity of further absorption of water, which has resulted the problem of water logging. Water logging problem is very high in Garhmukteshwar block [2.46 %] because of sloppy and eroded land. Muradnagar also facing this problem due to the mismanagement of upper Ganga canal which is passing through this block. It has also a miley sloppy land. Rest of blocks of Ghaziabad district having water logging problem which ranges from 0.50 percent to 0.07 percent and on average it is 0.70 percent.

Sometimes the blackish water comes near the surface and consequently with capillary action a thick layer of salt is deposited on the surface leaving the land saline and alkaline. The district is facing severe problem of alkalinity and salinity. Though the district is very much affected by green revolution, high doses of chemical fertilizers also results into salinity and alkalinity. The percentage increase in this category of land is between 0.01 percent in Rajapur- a less developed block to a 2.59 percent in Dholana.

On the other hand, groundwater depletion has gone downward during the past 10 years in whole Ghaziabad district. Most of the water in this district is used for drinking and irrigational purposed. Consequently, water table not only creates the problem of lifting water through tube wells, but also results the shortage of drinking water. As per the Soil Conservation Department, Ghaziabad, has declared Hapur and Loni as a Dark block where water level is above 75%. In these blocks , tubewells are not working properly, borring is totally fail and due to the growth of urbanisation and industrialisation the water is polluted. Whereas, Bhojpur and Dholana has water level between 50 - 60 % and considered as Grey blocks of Ghaziabad district. The groundwater level depleted in each blocks which ranges from 0.20 percet [Rajapur] to 1.55 percent [Dholana] followed by Hapur

Indices of Environmental Degradation (2000-01)

BLOCKS	Forest	Net sown Area	Fallow Land	Soil Erosion	Water logging	Salinity and Alkalinity	Grounwater Depletion	Composite Index
BHOJPUR	1.80	0.21	0.24	0.54	0.36	0.19	1.36	0.67
MURADNAGAR	0.10	0.25	1.04	0.66	1.08	0.31	0.31	0.54
RAJAPUR	0.61	0.34	0.12	0.39	0.50	0.01	0.20	0.31
LONI	0.65	2.36	1.44	1.19	0.46	0.47	0.78	1.05
DHOLANA	0.81	0.25	0.15	1.01	0.07	2.59	1.55	0.92
HAPUR	0.55	0.91	1.60	0.66	0.34	0.58	1.36	1.00
SHIBHAWALI	0.81	1.14	1.31	1.12	0.36	0.48	0.96	0.88
GARHMUKHTESHWAR	1.52	0.06	0.69	0.82	2.46	0.57	0.38	0.93
TOTAL GHAZIABAD	0.85	0.69	0.82	0.92	0.70	0.65	0.78	0.78

Level of Environmental Degradation

Categories	Index Range	No. of C.D.B	Name of Community Development Block
High	> 1.00	2	Loni , Hapur
Moderate	1.00 - 0.50	5	Garhmukhteshwar, Rajapur, Dholana, Shimbhawali, Muradnagar
Low	< 0.50	1	Bhojpur
TOTAL		**8**	

[1.36%]. On an average the district having groundwater level is 0.86 percent. Level of environmental degradation has been assessed during 2000-01 at block level taking seven indicators which is shown in Table No. 5.

REGIONS OF HIGH ENVIRONMENTAL DEGRADATION

The regions having high environmental degradation in Ghaziabad district includes Hapur [1.05 %] and Loni [1.00 %] blocks respectively. These regions belongs to the high agricultural productivity ie., the condition is very much true that higher the level of agricultural development more is environmental degradation. Hapur belongs to high category of environmental degradation in soil erosion, fallow land and groundwater depletion. Whereas it has moderate net sown area, forest and salinity and alkalinity and low waterlogging. The reason behind this is that Hapur comes in developed urban centre of Ghaziabad district But in case of Loni block there is high environmental degradation in soil erosion, net sown area and fallow land because it also belongs to one of the developed urban centres which is facing all kind of problems due to its location and infrastructure.

REGION OF MODERATE ENVIRONMENTAL DEGRADATION

The regions belong to moderate category of the district includes having composite index such as Garhmukteshwar [0.93 %], Shimbhawali [0.88 %], Bhojpur [0.67 %], Muradnagar [0.54 %] and Dholana [0.92 %] respectively. The status of these blocks is not constant in case of all selected indicators of environmental degradation, but by and large they fall in moderate category. However, Garhmukteshwar belongs to high category of forest degradation and water logging, to lower category in net sown area and

ground water depletion, and to moderate category in the remaining indicators of environmental degradation. Whereas, Dholana block having soil erosion [1.01 %], salinity and alkalinity [2.59%] and groundwater depletion [1.55 %] in high category of environmental degradation. Similarly, forest degradation falls in moderate category and rest of the category having low environmental degradation. In Shimbhawali block high environmental degradation belongs to net sown area, fallow land and soil erosion. Whereas, groundwater depletion [0.96 %] and forest [0.81 %] falls in moderate category and rest of the indicators having low category. In case of Muradnagar block , fallow land [1.04 %] and waterlogging [1.08 %] falls in high category, whereas except soil erosion [0.66 %] which comes in moderate category rest all the indicators falls in low category. In Bhojpur block, only forest [1.80 %] falls in high category and soil erosion [0.54 %] in moderate category. Rest all indicators falls in low category of environmental degradation.

REGIONS OF LOW ENVIRONMENTAL DEGRADATION

The region having composite index less than 0.50, includes Bhojpur [0.31] falls in low level of environmental degradation. This region belongs to low level of agricultural development that's why it has least environmental problems in comparison to other blocks of Ghaziabad district. Only forest area and waterlogging falls in moderate category, and rest all the indicators such as net sown area [0.34 %], fallow land [0.12%], soil erosion [0.39 %], salinity and alkalinity [0.01 %] and groundwater depletion [0.20%] falls in low category of environmental degradation.

On the basis of above Table No. 5 map has been prepared for showing the level of environmental degradation into High, Moderate and Low category during the year 2000-01 of Ghaziabad district. Catographic techniques has been used to indicate the level of environmental degradation in Fig No. 7.

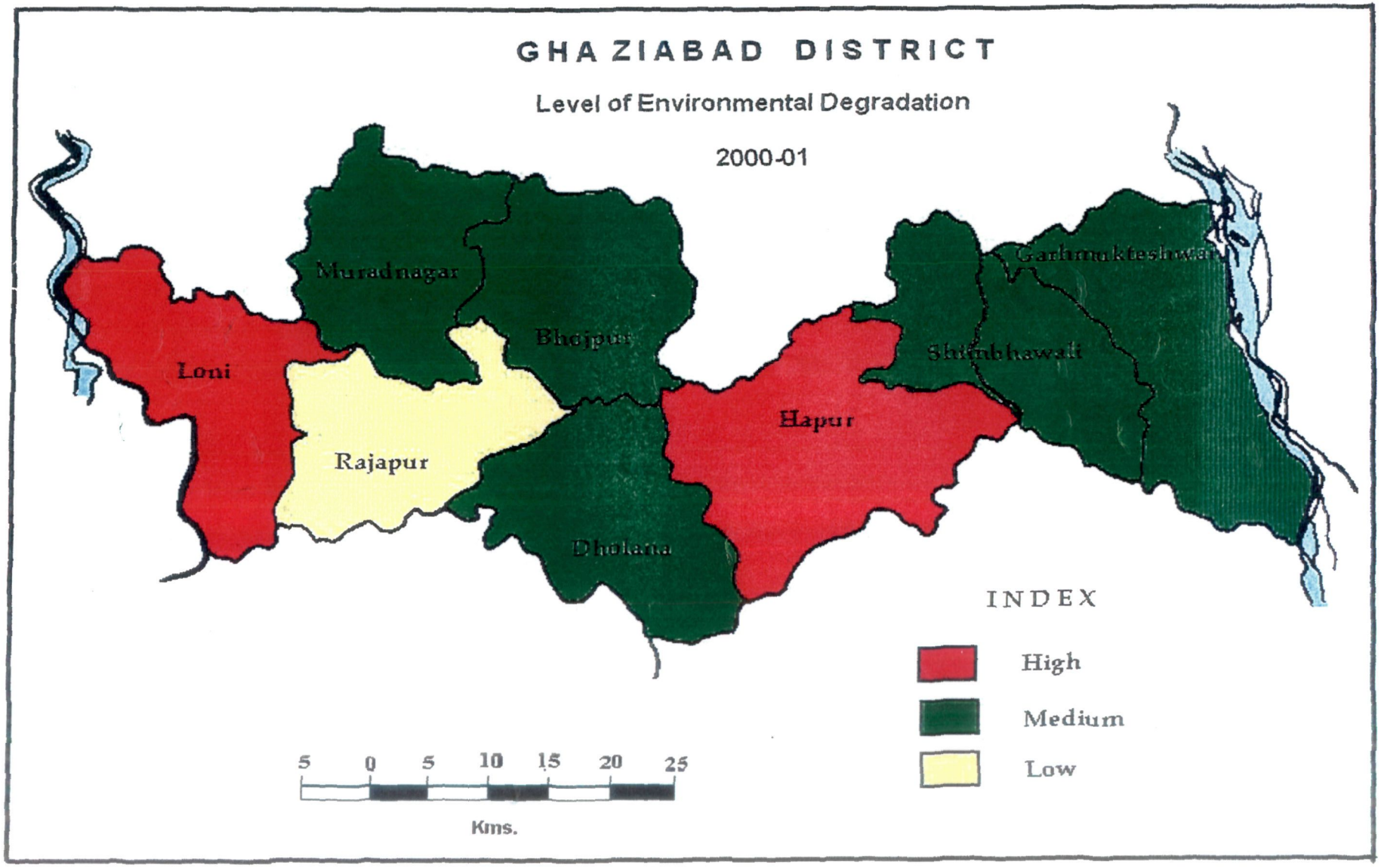

GHAZIABAD DISTRICT
Level of Environmental Degradation
2000-01
Muradnagar
Bhojpur
Loni
Rajapur
Dholana
Hapur
Garhmukteshwar
Shimbhawali
INDEX
High
Medium
Low
5 0 5 10 15 20 25
Kms.

Fig No. 7

GROUND WATER POTENTIAL

As per NEERI.(National Environemental Engineering Research Institute, Nagpur) report about 70 percent of the ground water in the country is polluted. In many parts of the country extraction of groundwater has been extensive. The total water resource potential of India, considering surface and groundwater, is estimated of 1869 km^2. The total replenishable groundwater potential is roughly around 431 km^2/ annum. After making provision for drinking, industrial and other purposes (other from irrigation) which is about 15% of the total potential available for irrigation is only 360 km^2/ year. Thus, a total of 1050 Km^3 of utilizable quantum of surface and groundwater is available for irrigation. In 1998, Directorate of Groundwater Development, Uttar Pradesh, has declared 111 blocks out of 819 blocks as dark where groundwater is already exploited to the extent of 85 percent and above. One hundred and ninety eight blocks are declared grey which have utilized between 65 to 85 and 510 as white where groundwater is exploited below 65%. Thus, lowering of groundwater table is another problem. Most of the areas have ground water level below 15m from the surface. Lowering of groundwater table has caused saline water intrusion in coastal areas. Declining water table has also resulted in increased energy consumption and more investment on operative cost of tubewells. Thus, rapid expansion of groundwater exploitation under the aegis of green revolution has already put extreme stresses on static resources and ecological equilibrium.

The district is one of the agriculturally developed region in western U.P. So, the dependency on groundwater is generally high throughout the district. The entire population depends for drinking water on groundwater only. The needs for drinking and irrigation are met from groundwater.

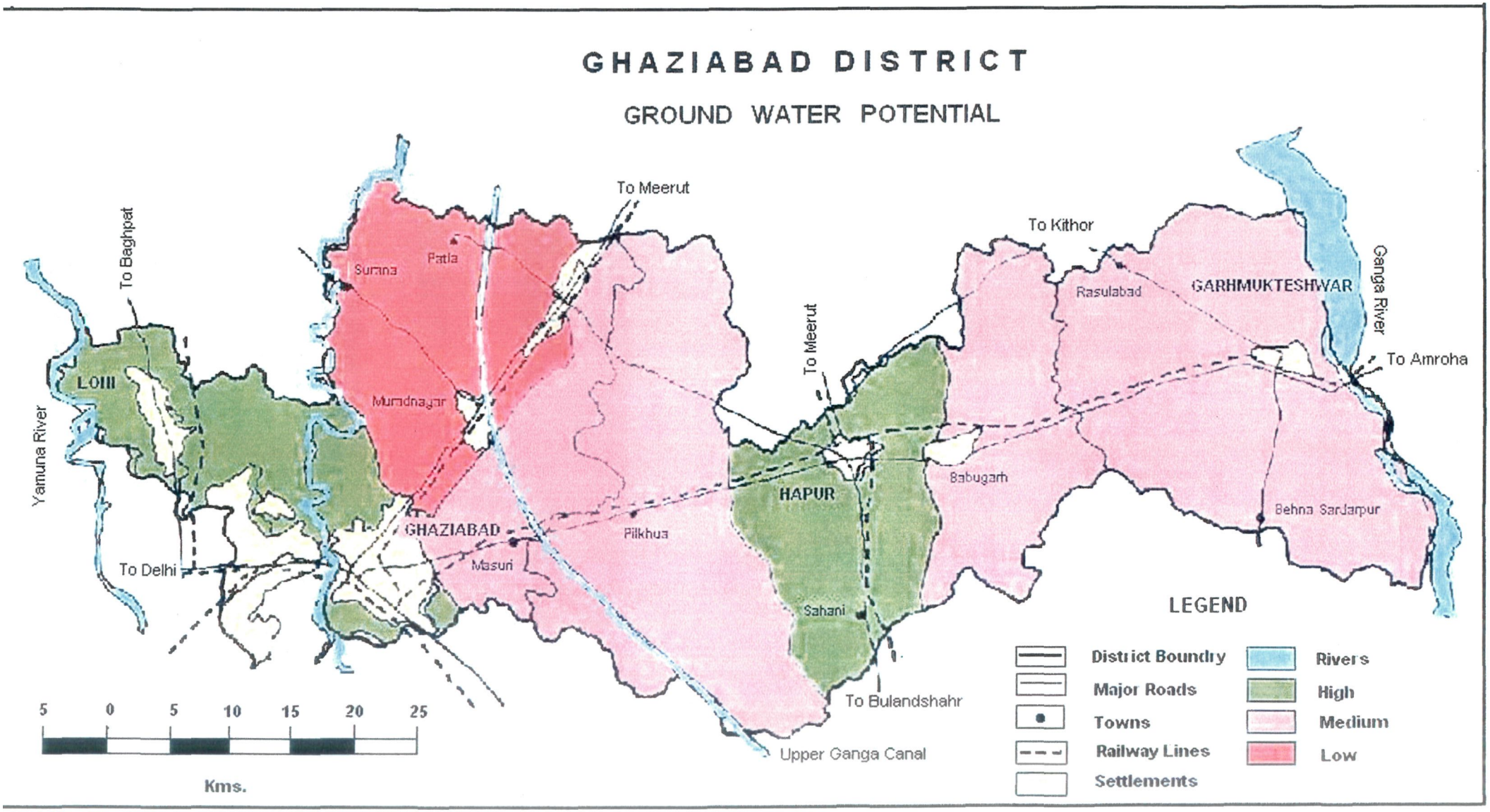

GHAZIABAD DISTRICT
GROUND WATER POTENTIAL
To Meerut
To Baghpat
To Kithor
Ganga River
To Amroha
To Meerut
Yamuna River
Sumna
Patla
Rasulabad
GARHMUKTESHWAR
LONI
Muradnagar
Babugarh
HAPUR
GHAZIABAD
Pilkhua
Behna Sarjarpur
To Delhi
Masuri
Sahani
To Bulandshahr
Upper Ganga Canal
5 0 5 10 15 20 25
Kms.
LEGEND
District Boundry
Major Roads
Towns
Railway Lines
Settlements
Rivers
High
Medium
Low

Fig no. 8

In India, about 79.15% of irrigation is provided by groundwater , but in Ghaziabad district only 56.95% of groundwater potential is estimated during 2000-01

The Fig No. 8, indicates the availability of the groundwater in the district. It shows the availability and insufficiency of groundwater in the district. The groundwater potential map of the Ghaziabad district is based on utilizable groundwater in mcm/yr/ km^2 [million cubic metre per year per square kilometer]. The range of utilizable groundwater in various development blocks of district Ghaziabad varies from less than 0.2 mcm/ yr/ km^2 to nearly 10 mcm/ yr/ km^2. Different areas of the district are divided into 'High', 'medium', and ' low potential areas. In the high potential areas, the utilizable ground water is more than 0.5 mcm/ yr/ km^2 which includes, Hapur, Loni and some part of Rajapur block. Where as, in the ' medium' potential areas it is between 0.2 mcm/ yr/ km^2 to 0.5mcm/ yr/ km^2 which includes Garhmukteshwar, Shimbhawali, and some parts of Rajapur, Modinagar, Muradnagar blocks. In the low potential area, the utilizable groundwater is less than 0.2 mcm/ yr/ km^2 which includes, Muradnagar . The data and map has been taken from the Zoning Atlas map of Ghaziabad District which is prepared through GIS technique by the U.P Pollution Control Board, Central Pollution Control Board, Shahdara, New Delhi for the year 1997.

SURFACE WATER

Surface water has been termed as a grossly underlised and wasted resources. The present utilization is around 30 cubic km^2. The utilization which was 100 percent before 1951 fall to 86.9 percent in 1998-99. There is a massive wastage of water used for irrigation. About 45 percent is lost by seepage through unlined field channels and another 15 percent is wasted through over irrigation.

STATUS OF SURFACE WATER USE IN GHAZIABAD DISTRICT

The surface water use in the District is categorised as high, medium and low. High use includes [I] water shades [upto 15 km] of river , streams and water body stretches feeding to drinking water sources, organised outdoor bathing, progation of wild life and fisheries and industrial water supply, and (ii) areas know to be dependent entirely on surface water sources for domestic waste supply. 'Medium' use includes water sheds adjacent to the above water shades. ' Low' use includes watersheds that don't have significant use/ dependency. The use is 'high' in the areas lies between east of Anupshahr branch of Ganga canal and river Ganga. There is an organised bathing place on the bank of river Ganga near Garhmukteshwar where every year during Kartik Prunima laks of people taking holy dip. The use of surface water is 'low' in the area lying between upper Ganga Canal and Anupshahr branch. The use is 'medium' in the areas lying both sides of Hindon river. The areas close to river Yamuna have 'low' use. The stretch of river Yamuna near the District has virtually no fresh water flow.

SURFACE WATER QUALITY

The water quality in different rivers of the District is classified as high/ medium/ low. The 'high' quality indicates that water is fit for drinking purposes. The 'low' use indicate that water is not suitable for irrigation purpose. The water quality of river Ganga is 'high' whereas the quality of water of river Kali is 'low'. Infact , Kali is virtually a dead river carrying only sewage. The water quality of river Hindon is 'Medium'. The water quality of river Yamuna is low as it is very much polluted and not fit for drinking purpose. The water qualities of all the canals are 'high' and used for irrigation purpose in Ghaziabad district. Water quality of different rivers / canals in Ghaziabad district has

been shown in the Table No. 6. It gives a clear details about the water quality of the rivers/ canals during the year 1997. River and canals includes, Hindon river, Kali nadi, Upper Ganga canal of Ghaziabad district.

Table 6

Water Quality of Different Rivers/ Canals in Ghaziabd District

LOCATION	HINDON		KALI NADI	UPPER GANGA PLAIN		
	U/S Hindon Bridge Ghaziabad	Kuleshra Bridge	NH - 24	Ghaziabad Hapur Road	Ghaziabad Modinagar Road	Anupshahr Branch
PH	7.81	8.02	7.80	7.86	7.85	8.25
Do (mg/ l)	—	5.60	0.00	——	——	7.50
Conductivity(um hos/ em)	688.00	643.00	1180.00	205.00	198.00	206.00
T. Hardness (mg/l)	266.00	234.00	344.00	110.00	150.00	126.00
Boron (mg/ l)	0.36	6.67	2.18	0.09	——	-----
NH3 (mg/ l)	1.61	2.20	12.46	0.17	0.04	0.01
COD (mg/ l)	91.00	43.00	296.00	8.00	3.00	8.00
BOD (mg/ l)	22.00	4.00	120.00	1.00	1.00	1.00

Source : Zoning Atlas Map of Ghaziabad District, Central Pollution Control Board, New Delhi November (1995)

The water quality data of river/ canals are given in Table No. 6 are the efforts which are being put in under the Yamuna action Plan and the Ganga Action Plan to restore the water quality in these rivers. As well as all parameter except pH are in mg/l of Ghaziabad district.

SOIL AND SOURCES OF SOIL DEGRADATION

The role of soil in the environment can be divided into two parts. Firstly, it forms part of the natural and artificial environment and by joining the spheres of air and water [atmosphere and hydrosphere] it is one of the ecosystem constituents along with the community of living organisms. On the other hand it is merely a physical receptor of matter and energy flows reaching the Earth surface, transforming and partly storing them [Stefanovits, 1972].

Soil biota plays an important role in maintenance of soil fertility because of their ability to carry out biochemical transformations and also due to their role as a source and sink for minerals [Jenkison, D.S and Ladd, J.N ., 1981]. By its fertility, soil, an important component of the habitat, contributes not only to the existence of the vegetation and of the fauna living on it but also the welfare of humanity. The decrease in soil fertility is, therefore, an important indicator of environmental pollution. The main aim of agricultural production is to maintain and increase soil fertility. Soil fertility holds the key to soil quality which has aptly been defined as the quality of a soil to produce safe and nutritious crops in a sustained manner over a long term to enhance human and animal health without impairing the natural base or harming the environment [Chhonkar, P.K and Rattan, R.K. 2000].

The land surface of the country is spread in an area of 329 million hectare and is predominantly covered with red soils [105.5 million ha], black soils [73.5 million ha], alluvial soils [58.04 million ha] laterite soil [11.7 million ha], desert soil [30 million ha] and hill and tarai soils [26.8 million ha]. Soil is a finite, non elastic and non-renewable asset. These soils are suffering from one or multiple problems like water [148.9 million ha] and wind [13.5 million ha] erosions, soil acidity [25 million ha; soil pH< 5.5], waterlogging [11.6

million ha] and salinity [10.1 million ha]. Over 5000 million tones of top soil alone is lost every year through erosion resulting a loss of around 8 million tones of plant nutrients and 3 million tones of foodgrain annually [Prasad, R.N and Biswas, P.P, 2000].

Soil degradation has posed a potential threat to ecological balance and sustainability of livelihood system of the people due to indiscriminate use of land water and other natural resources. Degradation of land and the rural biosphere in general arises from 2 major sources. (i) from the deforestation on account of the loss of vegetation cover, resulting in low productivity of soil, and (ii) the ignorance of proper soil an water conservation practices crop rotation, non- judicious use of fertilizers and pesticides, faulty irrigation and water management, discharge of industrial affluents, sewage caused by waterlogging, salinity, contamination of soil and groundwater affecting the soil health vis- a –vis crop productivity.

It has been noted that as the level of soil degradation increased, farm production decline due to [i] decline in crop productivity per unit area, and [ii] under severely degraded soils farmers were not able to grow any crop and had to keep the land fallow.

CHAPTER- IV

MAJOR ECOLOGICAL CHALLENGES TO AGRICULTURE

With the introduction of Green Revolution, agricultural development took place very rapidly but it also effected the ecology and give rise to various ecological problems, such as the depletion of forests, reduction of pasture lands, salinization, water logging, soil erosion, lowering of ground water table, soil, water and air pollution, reduction in biodiversity, decline in soil fertility, silting of rivers and emergence of several diseases and health hazards. But due to intensive efforts made to enhance food production for increasing population, high pressure was put on land, and not only the waste land was reclaimed to increase the net sown area but also the land under forest and pastures were shifted to cultivation to a considerable extent (Pankaj Srivastava, 1995).

In agriculture context, environmental degradation is a complex problem which is being increasingly faced with the passage of time. It has infact reached to its alarming stage at the turn of this century when unsustainable agricultural development practices have been adopted across the country, of course at different level. Most of the problems of environmental quality have resulted from either some wrong practices of landuse or from excess indulged in by the man himself. Problems of soil erosion and land degradation are almost wholly man made. They are the result of practices such as cultivation on steep slopes, overgrazing, leaving the land tilled and bare during the dry season and deforestation etc. Generally a lack of knowledge about land suitability and land capability is the indirect cause of such evils. Deforestation either for the sake of fuel, fodder and timber or for expansion of agricultural land or both heavy but unscientific doses of chemical fertilizers without understanding the actual requirement of the soil; irrational use of irrigation water with

mismanaged canals, extraction of underground water with of the upper acquifer instead of from the deeper and lower acquifer through tubewells especially for irrigation purposes; over cultivation without proper rotation of crops; and over grazing of animals without understanding the potentially of pastures and grazing lands, has resulted into severe environmental degradation specially the land degradation.

There are many causes for environmental pollution in rural areas.

1) Mismanagement of natural resources.

2) Poor hygiene and sanitation.

3) Use of agro-chemicals and fossil fuel.

4) Impact of Industries.

Another problem which is emerging in Ghaziabad district due to industrialization and urbanization is decrease in the quality of soils either due to anthropogenic sources or natural sources which is called soil pollution. The main factor of soil pollution are accelerated rate of soil erosion consequent upon major land use changes (eg. deforestation); excessive use of chemical fertilizers, pesticides, insecticides and herbicides , polluted waste water from industrial and urban areas, a few micro- organisms; forest fires, dumping of urban and industrial solid wastes, waterlogging and related capillary process, leaching process etc.

LAND DEGRADATION AND POLLUTION

Land degradation is the result of physical, chemical and biological processes and mechanisms which are interlinked with each other. Land degradation can also be considered in terms of loss of actual or potential productivity or utility as a result of natural and

anthropic factors, it is decline in land quality or reduction in its productivity and environment regulatory capacity.

BLOCKWISE STATUS OF LAND DEGRADATION

Inefficient use of water resources [irrigation] has intensified the process of land degradation, viz., Soil erosion, waterlogging, alkalinity, acidification and salinization etc. It is estimated that an area of 174.2 million ha is potentially exposed to various degradation forces like water (153.2 m ha) and wind erosion 15.0 Mha), about 40.0 Mha is subjected to floods and 22.0 Mha is not reclaimable for agricultural uses. An area about 25.0 Mha is affected by acidity having pH value below 5.5 and 33.7 Mha is degraded because of specific problems like waterlogging (8.5 Mha), Sodicity(3.6 Mha), Shifting cultivation (5.0 Mha), ravine and gullies (4.0 Mha) and 2.37 Mha to riverine and torrent lands (Singh, 1988).

Man has directly or indirectly use the land more extensively and intensively and applied more of technology and industrial inputs which caused numerous problems of land degradation. Basically, soil and water are two most seriously affected problems in Ghaziabad district. The problems of salinity and waterlogging are also directly affecting the agricultural production and farm income of the farmers.

Table - 7

Blockwise Status of Land Degradation in Ghaziabad District

(2000-01)

BLOCKS	SOIL EROSION		WATER LOGGING		ALKALINE SOILS	
	Area in ha.	%	Area in ha.	%	Area in ha.	%
Bhojpur	547	2.45	330.00	1.48	160.00	0.72
Muradnagar	715	3.25	58.50	0.26	104.00	0.47
Rajapur	577	3.01	232.00	1.24	156.00	0.83
Loni	520	2.01	293.00	1.31	75.00	0.29
Dholana	795	3.49	442.00	1.94	879.00	3.86
Hapur	1210	3.92	465.00	1.51	15.00	0.05
Simbhawali	445	2.06	583.00	2.70	60.05	0.28
Garhmukhteshwar	763	2.26	2107.26	6.24	22.40	0.07
Ghaziabad Total	7731	3.85	4748.45	2.36	1417.25	0.71

Source: Soil Conservation Department, Ghaziabad, U.P (2000)

Table No. 7 shows the blockwise status of land degradation during 2000-01 of Ghaziabad district. Soil erosion in general is one of the crucial problem of Indian agriculture but it is more in agriculturally developed region.

SOIL EROSION

Soil erosion is the most serious factor of land degradation. It results in huge loss of nutrients in suspension or solution, which are removed away from one place to another thus causing depletion of nutrients or enrichment of nutrients. It is very important because of its associated effects on crop production and water pollution. Due to this, tremendous amount of sediments is removed from the soils by surface run off (water erosion) and to lesser extent by wind erosion.

Soil erosion affects almost 174 million ha of the country 329 million ha of the territory (Government of India , 1989). It becomes a crucial problem in agriculturally developed regions. As Ghaziabad is also an agriculturally developed region, it is also facing this problem due to excessive cultivation which makes the soil loose and more susceptible to erosion. Table- 7 shows that maximum erosion is in Hapur block because most of the agriculture land has been converted into commercial and industrial purposes . It is one of the urban center of the Ghaziabad district and very much influenced by its location . The depletion of the forest and over-cultivation has made the soil infertile and loose . Hapur block contain 3.92 % of soil erosion followed by Dholana (3.49 %), Muradnagar (3.25 %) .

WATERLOGGING

Waterlogging the Centre of irrigation has defined the water logged areas as those where the water table rises so high that it affects the growth of plants adversely. Waterlogging is a condition in which groundwater level rises resulting in the reduced land productivity and sometimes its becoming unfit for cultivation altogether. Extensive waterlogging poses a great threat to soil productivity and environmental ecology specially in the irrigated areas. There are two important causes of waterlogging (i) when the natural drainage system

is disturbed and distorted (by the roads, canals, construction of houses etc.) resulting in waterlogging and sometimes forming small ponds , (ii) canal irrigation leads to waterlogging condition through seepage.

Western part of Ghaziabad is highly affected by waterlogging problem which includes Garhmukhteshwar and Simbhawali blocks of Garhmukhteshwar tehsil . The river Ganga passes from its border in a distorted way and made small patches of ox-lake and ponds in Garhmukhteshwar block . Table shows that in comparision to other blocks Garhmukhteshwar contain 6.24 % area under waterlogging, followed by Simbhawali (2.70%) according to 2000-01 whereas, Muradnagar (0.47%) shows less area affected by waterlogging.

ALKALINITY AND SALINITY

Basically, *Bhur* soils are alkaline and saline in Ghaziabad district. Most of the alkaline land is found near Bhojpur, Dholana, and Loni Blocks of the district. Khadar soil which is rich in nutrient alkaline in reaction (pH 6-8) which is deficient in organic materials specially phosphorus and an sandy loamy texture. Table No. 7 shows that during 2000-01 the maximum land under alkaline soils is in Dholana block i.e. 3.86% followed by Rajapur (0.83%), whereas Garhmukteshwar block (0.07) is almost negligible. The major problems in growing crops on saline soil are poor germination, patchy stand, stunted growth and low or no yield. To solve this problem much more methods adopted for reclamation of saline and alkaline soil are important in a drainage application of organic manure and gypsum use of molases and pyrite, replacement of soil etc.

WATER DEPLETION AND POLLUTION

Water pollution is second major problem facing agriculture in Ghaziabad district. According to Felfody's (1972), " Water pollution has every impact which changes the quality of our surface and sub soil waters to such a degree that its suitability either for human consumption or for the support of man's natural life process will decrease considerably. Throughout the world, regions that have sustainable groundwater balance are shrinking day by day. Three problems dominated groundwater use : (i) depletion due to over usage, (ii) waterlogging and salinization due to mostly to inadequate drainage and insufficient conjunctive use, and (iii) pollution due to agricultural industrial and other human activities. Almost 80% water taken from rivers, lakes, streams and aquifers - use for agriculture in India.

Water pollution are of two types: (i) Ground water pollution, and (ii) Surface water pollution. Both surface and ground water can get contaminated by agricultural chemicals such as chemical fertilizers and pesticides. The growing use of chemicals to improve yields, has degraded the quality of returns flows to rivers as well as percolation to ground water. Nutrients loads also affect the ecology of receiving waters.

GROUND WATER POLLUTION

Ground water is polluted through a variety of sources viz. Leaching and downward movement of pollutants from agricultural field such as nitrates, phosphorous, potash and several insecticides and pesticides, from industrial dumping areas, from urban and rural garbages etc. The loose and friable sandy soils, high water table and moderate to high rainfall accelerate the rate of infiltration of rainwater and rapid downward movement of pollutants with percolating water. Generally, industrial wastes including waste water are dumped

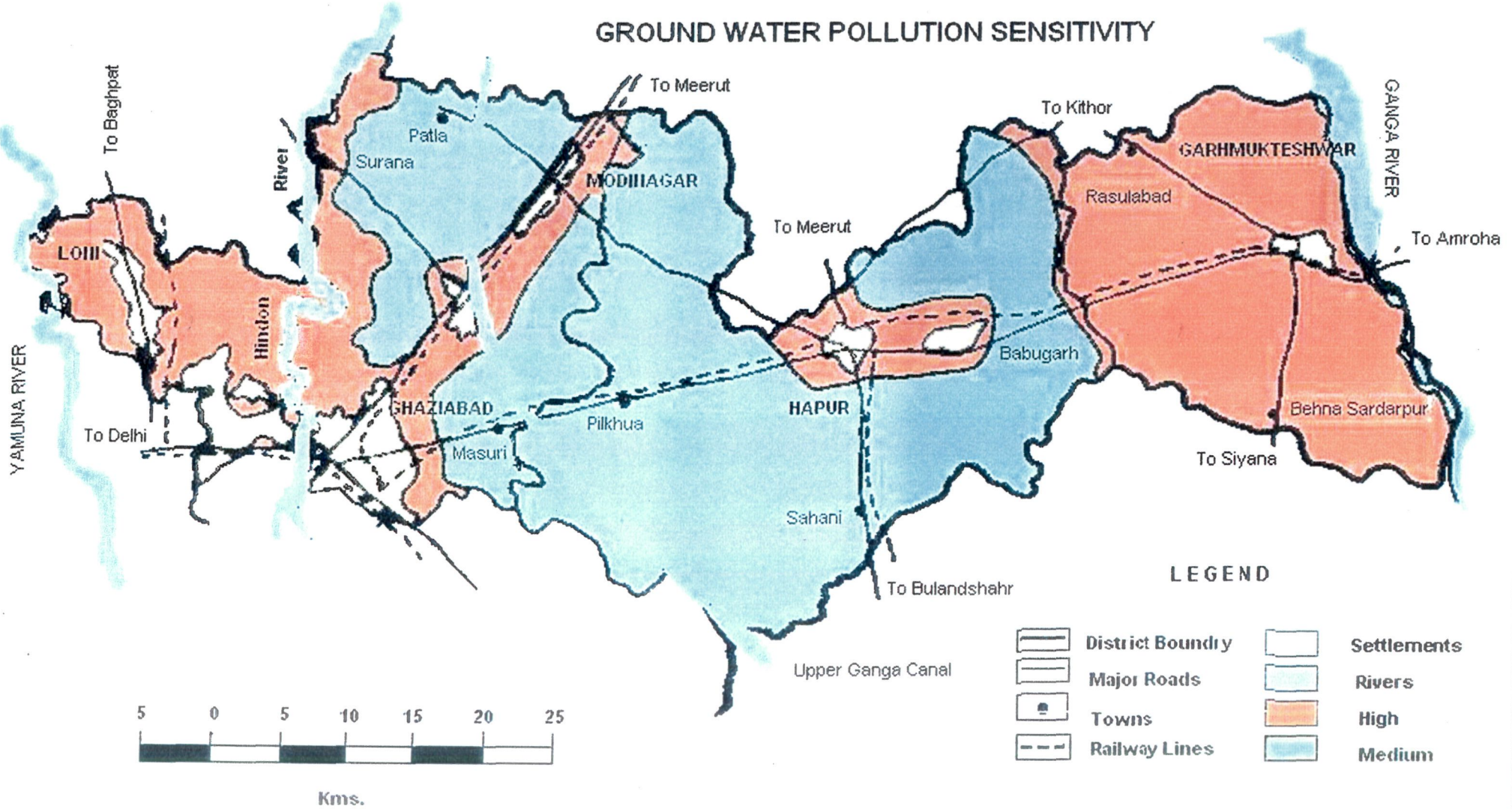
where, streams are not available in the nearby areas. Same situation is found in the areas of Ghaziabad district which is facing this problem and made the ground water level very low. The groundwater pollution of Ghaziabad district has been shown through Ghaziabad Pollution sensitivity in Fig. No. 9 which is prepared by Central Pollution Control Board, New Delhi, based on ground water quality map, groundwater potential map, and groundwater use.

The groundwater pollution sensitivity map determines risks on discharging effluents on land of deposing solid/ hazardous wastes on land. Map clearly shows the 'high' groundwater pollution sensitivity found in the western and eastern parts of the district as well as around Hapur and Bahugarh area. In the western part, the 'high' sensitivity area include Loni, Ghaziabad, and along Ghaziabad - Meerut road. In the eastern part it includes entire Garhmukteshwar development block. In central part, a small area surrounding Hapur and Bahugarh falls within 'high' sensitivity area. The rest of the areas in having medium sensitivity towards groundwater pollution. District has no low sensitivity areas and it is not suitable for disposal of solid wastes on land.

Data shows that the groundwater level has been decreased tremendously during past 10 years in whole Ghaziabad District. Before 15 years back, farmers used to rotate the crops 1 to 2 times, but now it goes up to 2-3 times crop rotation in the District. As per Soil Conservation Department, Ghaziabad, U.P has declared Hapur and Loni as a Dark block where water level is above 75%. In this block tubewells are not working properly, borring is totally failed and due to the growth of urbanization and industrialization the water is polluted. The solid wastes coming from industry polluting the soil and agricultural land. This factor is also playing major role in low water level in these areas. Bhojpur and Dholana blocks declared as grey where groundwater is exploited upto 50 to 60 percent.

GHAZIABAD DISTRICT

GROUND WATER POLLUTION SENSITIVITY



SURFACE WATER POLLUTION

Surface water specially river water is polluted through the mixing of different quantities of dissolved inorganic matter in the forms of ions. The major source of surface water is precipitation. Surface water pollution is caused by industries, urban centres, agriculture and other human activities. Discharge of urban sewage water, industrial effluents carrying industrial waste, washing and dumping of industrial waste, non- degradable and long lasting pollutants from sugar factories, beet- sugar refining has polluted the surface water in Ghaziabad district.

Increasing urbanisation and industries are responsible for the release of enormous quantities of pollutants of various kinds through sewage effluents into the water beyond permissible safety level. In recent, day by day over explosion of urbanisation and industrilisation, district is facing this problem. Agricultural fields are very much affected through surface runoff which removes chemical substance from the land applied to the agricultural fields in the form of chemical fertilizers, pesticides, insecticides and herbicides. Both the major rivers Ganga in the west and Yamuna in the east facing this problem very badly.

The surface water pollution has been shown in the Fig no. 10, prepared by the central pollution control board, New Delhi. The risk due to discharge of effluents into surface water are determined in terms of surface water pollution sensitivity. As the map, the 'high' sensitivity areas comprise of Ghaziabad tehsil , Hapur and Loni Blocks and Garhmuktehswar tehsil. The ' medium' sensitivity areas are within the Hapur block and part of Modinagar tehsil.

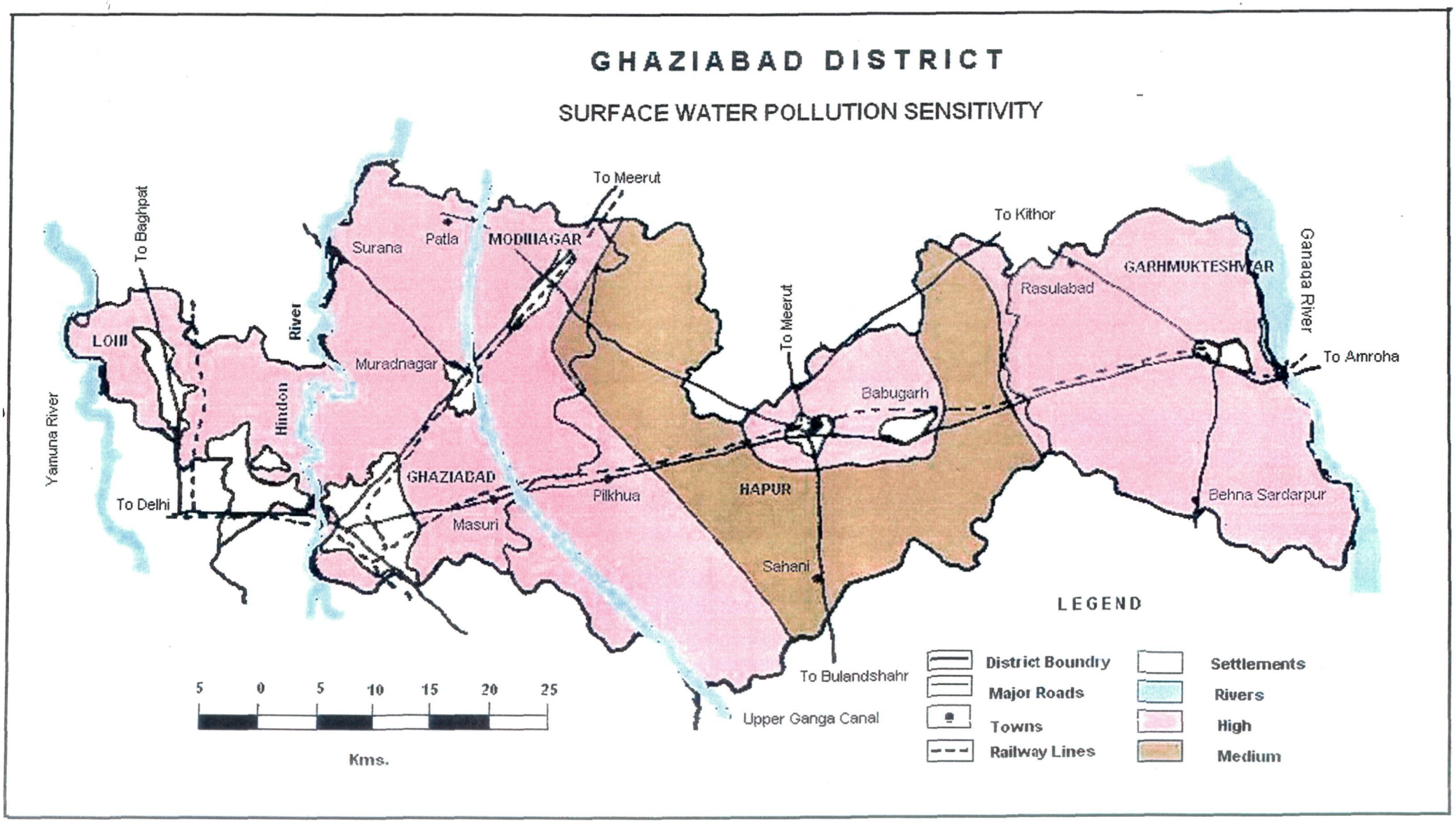

GHAZIABAD DISTRICT
SURFACE WATER POLLUTION SENSITIVITY
To Meerut
To Baghpat
To Kithor
Ganaga River
Surana
Patla
MODINAGAR
GARHMUKTESHWAR
Rasulabad
LONI
River
Hindon
Muradnagar
To Meerut
To Amroha
Babugarh
Yamuna River
GHAZIABAD
HAPUR
Pilkhua
Behna Sardarpur
To Delhi
Masuri
Sahani
LEGEND
To Bulandshahr
Upper Ganga Canal
District Boundry
Major Roads
Towns
Railway Lines
Settlements
Rivers
High
Medium
5 0 5 10 15 20 25
Kms.

Fig No. 10

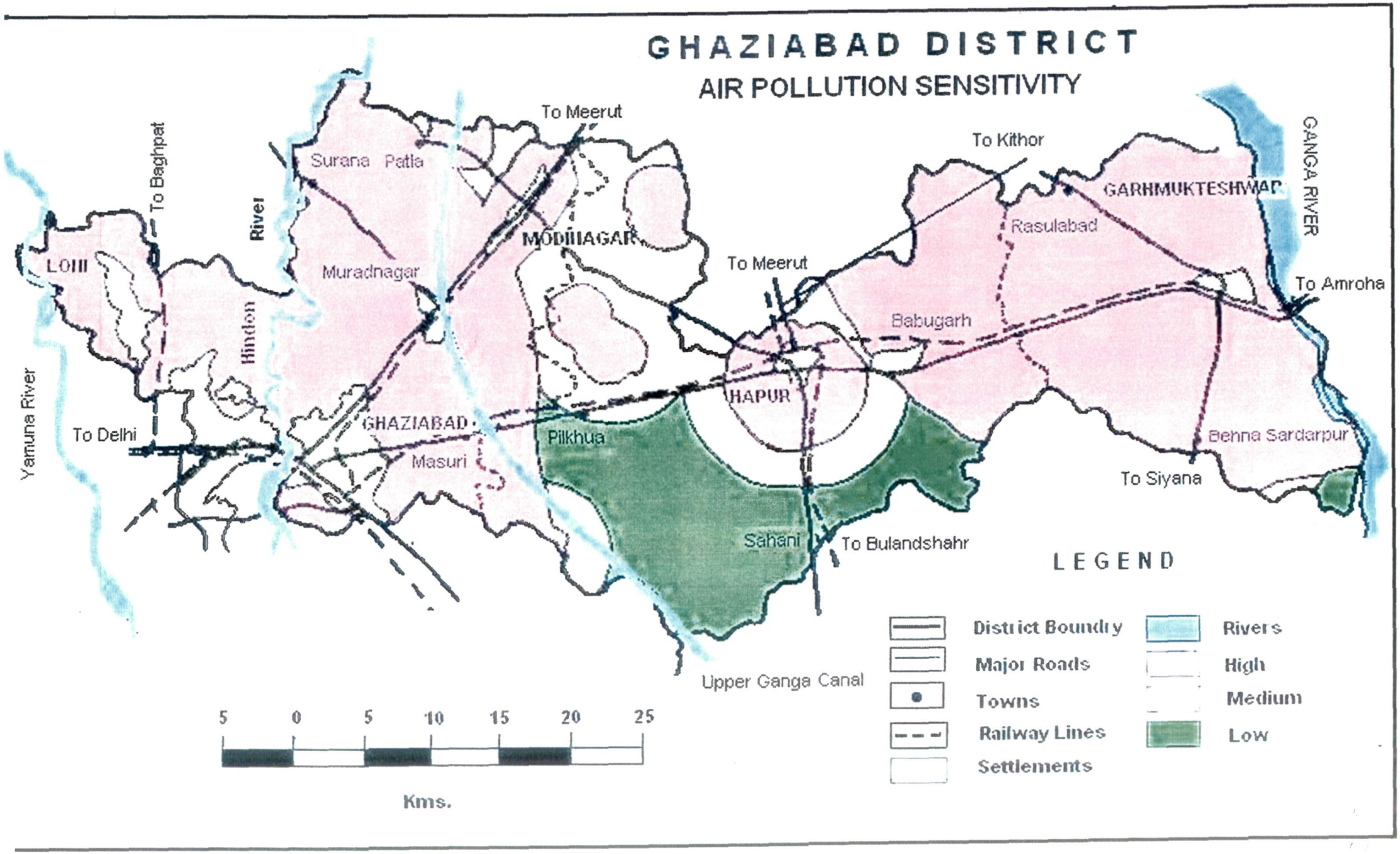
AIR POLLUTION

In geneal air pollution may be defined as the disequillibrium condition of the air caused due to introduction of foreign elements from natural as well as anthropogenic sources to the air so that the air becomes injurious to biological communities in general and human community in particular.

In Ghaziabad district, due to industrialization and urbanization it become a major problem and affecting the environment very rapidly. The areas close to Ghaziabad town are polluted with the levels of SO_2 and SPM exceeding the standards due to emission from the industries. The quality of ambient air in Ghaziabad town and upto 2km of its periphery is poor and area between the radius of 2 to 5 km is having medium air quality. In Modinagar the quality of ambient air within a distance of 2 km along both sides of the main road is 'medium'. Hapur town has a number of bone mills, and these are highly polluting in nature. The quality of air within 2 km from Hapur is bad and between 2 to 5 km , it is medium and beyound that it is good. In the Loni town, owing to a large number of industries and brick klins, the quality of air is medium. In low quality areas since the air is polluted no further air polluting industries should established.

Fig no.11 shows the air pollution sensitivity which is prepared by Central Pollution Control Board, New Delhi. The sensitivity of the air environment to pollution depends on the landuse of the region, the meterological characteristics of the area and the present air quality.

The dispersion sensitivity describes the ability of the area to disperse and dilute the air pollutants owing to its ventilating capacity micro as well as macro climate, vegetative cover and nature of the earth surface. In district Ghaziabad the terrain is plain with no hills and large scale undulation and also the climate is not adverse.


GHAZIABAD DISTRICT
AIR POLLUTION SENSITIVITY
To Meerut
To Baghpat
Surana Patla
To Kithor
GARHMUKTESHWAR
GANGA RIVER
Rasulabad
MODINAGAR
Muradnagar
LONI
Hindon River
To Meerut
To Amroha
Babugarh
Yamuna River
To Delhi
GHAZIABAD
HAPUR
Pilkhua
Masuri
Behna Sardarpur
To Siyana
Sahani
To Bulandshahr
LEGEND
District Boundry
Major Roads
Towns
Railway Lines
Settlements
Rivers
High
Medium
Low
Upper Ganga Canal
5 0 5 10 15 20 25
Kms.

Hence, the dispersion sensitivity for entire district is normal. Urban centres such as Ghaziabad, Muradnagar, Modinagar and Sahibabad facing air pollution problems in Ghaziabad district.

FOREST COVER / VEGETATION

After green revolution, agricultural development took place very rapidly but it also affected the environment. The forest cover has declined due to high pressure was put on land and the cutting of forest for expansion of agricultural land. Due to the excessive cultivation agricultural land has deteriorated and has become unfit for cultivation. This meagre forest caused the high rate of siltation. The high rate of siltation has not only reduced the life of reservoirs and made the water supply costlier, but also raised the river beds adding to the severity of flood problems, which in turn affects the environment and ecology.

Forest are being destroyed at a rapid rate, posing threat to the economy and environment. The country records 22.8 percent of land area under forests, of which only 10.88 percent farms the closed forests of adequate density (Singh R.B, 1995). Deforestation has increased because of large scale consumption of fuel wood. Majority of people, specially poor sections of the society depend on immediate surrounding forests to meet their basic needs. As the forest coverage decreases, the quality of life declines accordingly. Subsequently, the flora and fauna are vanishing and the question of biodiversity is looming ahead.

Forest play an important role to conserve the soils, upgrade its quality and check the soil erosion both from water and wind. It keeps free from pollution of air which comes from industries, re-chemical and thermal units. Forest are very essential for maintaining the water

resource availability. Moreover, forest are the main source of preserving bio-diversity of natural fauna and flora.

In Ghaziabad district the total area under forest is 2470 hectares which is 1.23 percent of the total reporting area. Garhmukteshwar Vikas Khand having more area under forest. But the situation of Muradnagar block is totally different from other blocks. It comes in industrial region and most of the forest area has been converted into commercial or industrial purposes which lead the soil erosion. Due to depletion of forest in Ghaziabad district, the ecological climatic conditions has been badly affected. Thus the forest cover in the district was left only small proportion which is in sufficient to balance the eco-system.

HARMFUL EFFECTS OF CHEMICAL FERTILIZERS

Abrol and Katayal (1990) warned that fertilizer should be used scientifically and in proper doses and ratios. They concluded that fertilizer application on a continuous basis can bring about nutrient accumulation which in turn can prove toxic to plants or interfere with the uptake of other essential nutrients. Singh, I.P et. al (1987) carried out a study on indiscriminate fertilizer use vis- a vis ground water pollution in Central Punjab. Evidences are there that the fertilizer use leads to increase in nitrate level in ground water or rise in atmospheric burden of nitrous oxide but found scanty.

Chemical fertilizer and chemical pesticides have been considered the most prominent factor causing environmental contamination. Besides this, high doses of chemical fertilizer also results into salinity and alkalinity especially when it is not supplemented with farmyard manure. Fertilizer is the key input for increased crop production. The most serious problem emanating out of the increased use of chemical fertilizer is the rapid

eutrophication of nitrogen of surface water bodies and excessive concentration of nitrogen and other chemical compounds in water as well as in the atmosphere. Excessive use of chemical fertilizer has in many cases led to the application of the law of diminishing returns.

The increasing trend of abundant use of inorganic fertilizers along with herbicides and pesticides, the practices of monoculture or two crop rotation and exploiting available water resources in the present intensive agriculture system cause or threat to the sustainability of our agro- ecosystem. The production and consumption of NPK nutrients in 1991-92 were 9.9 and 12.7 million tones in India. Currently India is using almost 17.5 mt plant nutrients (NPK) and likely to need 45 mt including 10 mt from organic sources by the year 2025.

The continuous use of chemical fertilizer reduces the humus content of the soil. In the absence of humus, the physical structure of soil under goes vast changes and the texture of fertile soil is lost, and ultimately soil may loose its water retaining and absorbing capacity (Rehman, F., 2001). Due to the excessive use of chemical fertilizer it deteriorated the soil structure as well as the texture, ultimately making the soil permanently sterile. It has been observed that the taste of products also goes on deteriorating by application of chemical fertilizers. Secondly, canal irrigation results in bringing the water table closer to the surface, which help the weeds to grow on cropland. Thus, causes problem of waterlogging (Das and Sarkar, 1972). Thirdly, to increase yield rate under intensive agricultural programme, high yielding varieties of seeds had to introduced which are again very much susceptible to insects and pests. To protect plants from these insects and pests, adequate measures in terms of the use of insecticides and pesticides is to be introduced, but is also polluted the entire surroundings firstly by causing the scope of natural control of harmful insects through biological enemity goes in vain, and secondly, in view of higher esistivity of injurious insects, higher doses

of insecticides are required which in turn enhances the danger of pollution.'(Basu, 1985).

And at the last, the development of irrigation potential has been another salient features of agricultural development while it has provided extended irrigation facilities need for enhancing the agriculture production it has turned some cultivated land into non suitable for cultivation by generating the problems of waterlogging and salinity due to increase water table.

CHAPTER - V

SUSTAINABLE AGRICULTURAL DEVELOPMENT

Agricultural development in a true sense, denotes the quality of agricultural system of a region in terms of productivity, diversification and commercialization consistent with a desired state of agrarian relations and ecological balance. In general, agricultural development in a particular region means, by an large the land productivity with the application of higher degree of modern inputs. Sharma (1971) pointed out that agricultural development should be assessed not only by level of productivity or trends in agricultural production but also with reference to various physical inputs like irrigation, fertilizers, improved seeds and extent of cultivated area since agricultural development depends on application of inputs like fertilizers and water, it is reflected in productivity of cultivated area as well as in income per holding. According to Ahluwalia (1978), agricultural development is taken as measured in terms of net domestic product generated from agriculture per rural person at constant prices, and not just in terms of availability of food. Agriculture is also defined broadly as the sustainable exploitation of renewable natural resources and includes annual and perennial cropping (Farrington, J. and Satish, S. 1995).

Agricultural development is a pre- requisite of economic growth in our country. Agriculture is important not only to meet the ever growing and ever pressing demand for food and fibres for human consumptions but also for providing forage for animals and raw materials for non- agricultural sectors. In this chapter we find out the level of agricultural development, ecological problems effecting the agricultural development and use of chemical fertilizer which is making the soil infertile for agricultural production. The study

proceeds with the assumption that agricultural development of any region depends mainly on the following factors :

(a) Irrigation facilities

(b) adoption of new technology

(c) availability of agricultural infra-structural facilities.

In this chapter , the landuse has been studied at district and block level of Ghaziabad District. With spatial distribution of landuse through remote sensing technique has been studied to know the actual pattern of landuse. Other than this level of agricultural development have been analysed to show the agricultural development at block level in Ghaziabad district at two point i.e., 1990-91 and 2000-01. Consumption of chemical fertilizer have been studied which is a major factor affected the soil and crop productivity after green revolution.

LANDUSE

Landuse is an important aspect of geographical studies and the progress of an area can be measured to a certain degree by the way in which its land is used and maintained. The landuse pattern is determined by several interrelated factors like the environmental, socio- economic and also the scientific management of the landuse. (Rao, V.L.S. Prakash, 1986). Landuse is any kind of permanent or cyclic human intervention to satisfy human needs, either material or spiritual from the complex natural and artificial resource which together are called land (Vink, A.P.A., 1975). Land is also one of the essential non-renewable resources of mankind. Properly speaking it is not a raw materials not quoted on the international market and by definition is linked to its own particular site (OECD, 1976).

Landuse refers to the purposes for which humans exploit the landcover. In other words, landuse is the intended employment or / and management strategy placed on land cover type by human agents or land managers. Common land uses include agriculture, grazing, forestry mineral extraction. Several examples illustrate the difference between land cover type soil, water and cultivated plants. In contrast to agriculture, a landuse refers to a system of human inputs and management that sustains this landcover.

The study of landuse pattern and associated factors for its change are very essential for formulating a plan for balanced growth of agricultural economy. This will helpful in locating the imbalances in utilization of land resources for crop production, forest and pastures for human and livestock population, and also to suggest a sustainable land used plan based on sound reasoning and scientific knowledge. Landuse utilization pattern can be studied in terms of four dimensions:

a) Physiography and water availability

b) Forestry

c) Availability of livestock

d) Natural and human constraint of land utilization

Environmental factors such as soil characteristics, hydrology, climate, topography and vegetation determine the landuse. It also reflects the land's importance as a fundamental factor of production. However, since the Industrial Revolution and the unprecedented increase in human population in the last one and two centuries, people have been playing an increasing role as agents of change in the earth's environment. (Ayode, 2002).

Landuse utilization of Ghaziabad district of the year 1990-91 to 2000-01 has been broadly categorized into 10 types. (Table 8). This table shows the area under different categories of landuse as percentage to total reported area between 1990-91 to 2000- 01 of Ghaziabad district.

Table 8

Land Utilisation of Ghaziabad District (1990-91 and 2000-01)

(Area in hect.)

S.NO	Land Utilisation	1990-91	%	2000-01	%
1	Forest	2556	0.99	2470	1.23
2	Land under non- agricultural purpose	37254	14.36	32686	16.26
3	Barren & uncultivated land	8455	3.26	5489	2.73
4	Cultivable waste	7773	2.99	3703	1.84
5	Pasture and grazing land	499	0.19	86	0.04
6	Miscellaneous trees, groves and saps	1553	0.60	230	0.11
7	Current fallow land	8785	3.39	9089	4.52
8	Other than fallow land	8637	3.33	5139	2.57
9	Net Sown Area	183943	70.89	142113	70.70
10	Total reporting area for land utilization	259455	100	201005	100

Source : District Statistical Handbook, Ghaziabad district, (1990-91 to 2000-01)

The percentage of area under forest is very low which essentially means intensive use of land for cultivation. The area under forest in this district is only 2470 hectares which is 1.23 percent of the total study area. The area covered by forest is merely 0.99 percent in 1990-91, while it was 1.23 percent of the reporting area in 2000-01. The land put on non- agricultural uses including areas under roads, railways, and settlements increased significantly from 14.36 percent

in 1990-91 to 16.26 percent in 2000-01. It was due to some land which was earlier under cultivation has now turned to residential and industrial sector in the district. Specially Modinagar tehsil, Muradnagar, Ghaziabad tehsil (Shahibad industrial area). While the barren and uncultivated area has declined from 3.26 percent to 2.73 percent in 2000-01. The percentage share of cultivated area other than fallow land also declined marginally under which the miscellaneous trees crops declined from 0.60 percent to 0.11 percent, while the category of pasture land declined tremendously from 0.19 percent in 1990-91 to 0.04 percent in 2000-01. However, there has been substantial change in the extent of cultivable waste land which declined from 2.99 percent to 1.84 percent in 2000-01. Likewise, the current fallow land has also undergone changes which is noted as 3.39 percent in 1990-91 to 4.52 percent in 2000-01.

Another major change has been observed in the percentage of net sown area which is decreased from 70.89 percent in 1990-91 to 70.70 percent in 2000-01 because of the percentage increased in the land use for non- agricultural purposes and current fallow land . The reason behind this that it is situated very near to Delhi and belongs within NCR region. As per the market demand, farmers are moving towards the cash crops either to other agricultural activities or to agro- based industry of horticulture As per our observation the area near Hindon river, were either vegetables or food crops are grown there, but now it has been turned into plantation and due to the growth of industrialization and urbanization, rural areas are much more affected by the ecological or environmental disturbances. The variation is worked out to be 12.69 percent during this decade in Ghaziabad district as whole.

Landuse pattern of Ghaziabad district has been shown through pie diagram for both year 1990-91 and 2000-01 in Fig no. 12.a and Fig. 12.b.

GHAZIABAD DISTRICT

LAND UTILIZATION (1990-91)

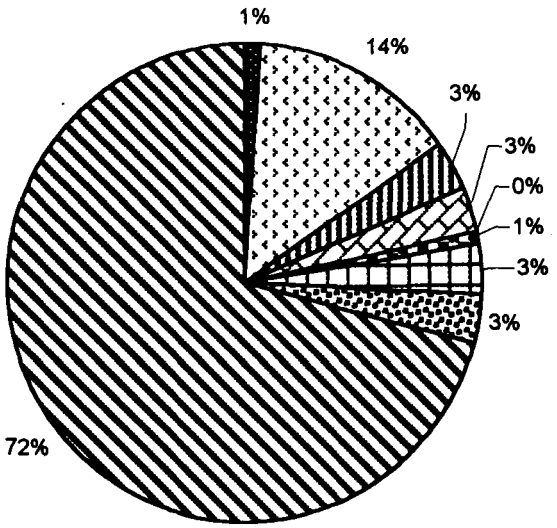


Fig. 12.a

Forest	Land used for non- agricultural purposes
Barren and uncultivated land	Cutivable waste
Pasture and grazing	Miscellaneous trees, groves and saps
Current fallow land	Other than fallow land
Net sown area	

2000-01

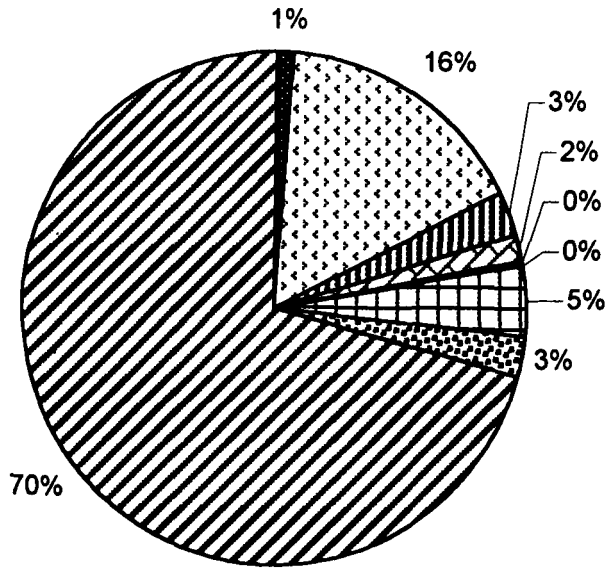


Fig. 12.b

BLOCKWISE LANDUSE PATTERN

As the study was put on block level of Ghaziabad district, the landuse pattern of each block has been categorized into ten types as mentioned earlier during 1990- 91 to 2000-01. The distribution of blockwise landuse pattern of Ghaziabad district there is a mere increase in forest during this decade because of increase of plantation, as well much attention was given by Government to increase forest area. Land put on non- agricultural purpose has also increased slightly in each block during 1990-91 to 2000-01 owing to urbanization and industrialization, the land has been used for development purposes. While Barren and uncultivated land has been reduced in each block except in Rajapur block which increased from 3.08 to 4.42 in 2000-01 whereas Muradnagar and Loni there is mere increase as shown in the table no. 9. Cultivable waste land has been decreased tremendously in each block of Ghaziabad district in which Loni Block shows major decline of cultivable waste land as the area is developing very rapidly due to urbanization as well as it is very near to Delhi and working as a one of the good market center. Pasture and grazing land during 1990-91 to 2000-01 in Garhmukteshwar, Shimbhawali and Hapur is negligible and rest of the block it is declined, whereas in Muradnagar, the data shows that in 1990-91 the area under this category is 0.06and it becomes zero percent during 2000-01. The current fallow land has been increased in each block out of that Muradnagar, Loni and Garhmukhteshwar shows a considerable increase i.e, 1.65% to 7.04%, 6.12% to 8.09% and 2.33% to 6.14% respectively and rest blocks have recorded slightly increase in current fallow land. Land under miscellaneous trees, groves and saps shows downward fall in each blocks and out of that Muradnagar shows decline from 0.43 percent to 0.09 percent during 1990-91 to 2000-01. The reason behind this is that the agricultural land is converting very rapidly to agro based industries, whereas other than fallow land is declining in each blocks. No doubt the net sown area

Table – 9

Blockwise Landuse Pattern of Ghaziabad District (1990-91 to 2000-01)

BLOCKS	I		II		III		IV		V		VI		VII		VIII		IX		X	
	1990-91	2000-01	1990-91	2000-01	1990-91	2000-01	1990-91	2000-01	1990-91	2000-01	1990-91	2000-01	1990-91	2000-01	1990-91	2000-01	1990-91	2000-01	1990-91	2000-01
GARHMUKHTESHWAR	1.99	2.93	10.75	11.54	5.19	4.05	2.91	1.77	0.00	0.00	0.80	0.27	2.33	6.14	3.70	2.75	72.33	70.55	100	100
SIMBHAWALI	0.12	0.18	11.55	11.76	0.32	0.37	0.51	0.28	0.00	0.00	0.06	0.02	0.87	0.90	0.70	0.63	85.87	85.86	100	100
HAPUR	0.33	0.49	11.74	12.65	0.77	0.82	0.49	0.31	0.00	0.00	0.27	0.07	0.95	1.62	0.96	1.16	84.49	82.88	100	100
BHOJPUR	2.29	3.26	10.46	12.02	3.30	2.96	2.10	1.10	0.11	0.06	0.40	0.25	1.00	3.71	1.24	2.60	79.10	74.04	100	100
DHOLANA	0.11	0.18	13.33	14.01	6.17	4.69	1.22	0.56	0.45	0.25	0.04	0.04	2.14	3.95	2.24	1.76	74.30	74.56	100	100
MURADNAGAR	0.86	1.26	11.63	12.92	0.74	0.81	2.49	1.32	0.06	0.00	0.43	0.09	1.65	7.04	2.61	2.01	79.53	74.55	100	100
RAJAPUR	0.29	0.43	17.85	20.00	3.08	4.42	2.68	1.23	0.03	0.02	0.21	0.06	1.04	4.66	3.88	2.20	70.94	66.98	100	100
LONI	0.25	0.37	25.78	31.99	3.51	3.84	11.85	7.51	0.06	0.05	0.11	0.06	6.12	8.09	8.88	6.74	43.44	41.35	100	100
BISRAKH	2.32	2.32	16.3		3.05		2.09		0.53		2.37		3.59		5.05		64.7		100	
DADRI	0.34	0.34	9.5		7.02		2.94		0.71		0.47		5.22		2.68		71.12		100	

SOURCE : Statistical book of Ghaziabad District for the year 1990-91 to 2000-01, Ghaziabad, U.P.

I- Forest
II- Land used for non – agricultural purpose
III- barren and uncultivated land
IV- Cultivable waste
V- Pasture and Grazing land
VI- Miscellaneous trees, groves and saps
VII- Current fallow land
VIII- Other than fallow land
IX- Net sown area
X- Total reporting area for land utilization

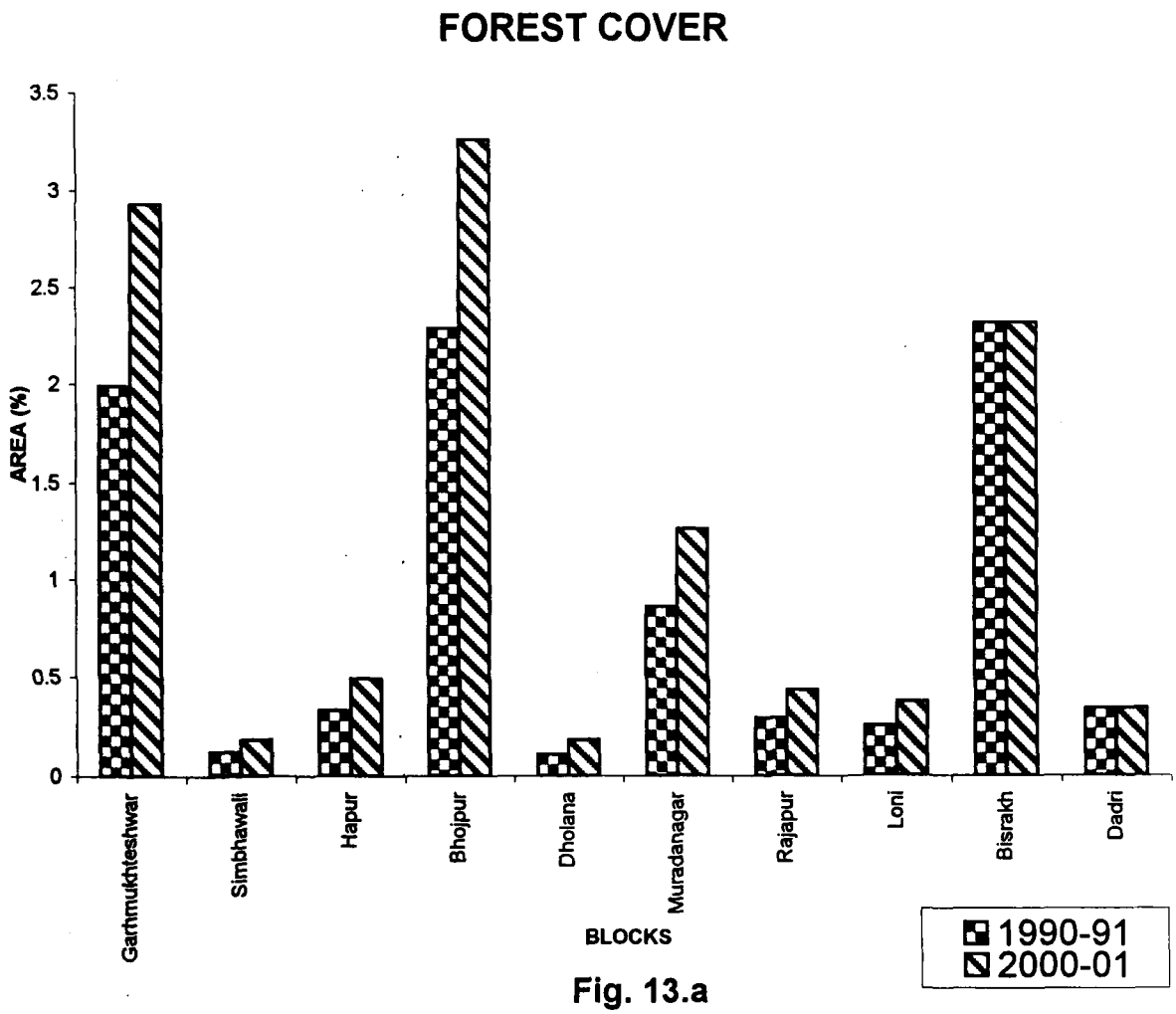


Fig. 13.a

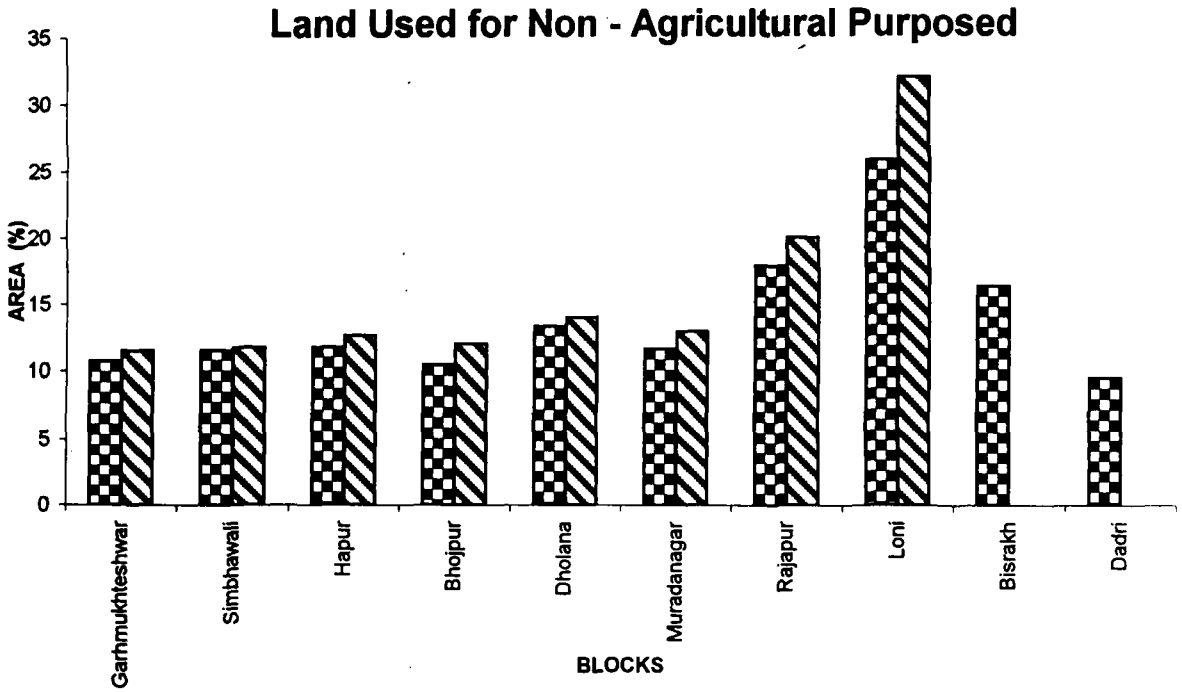


Fig. 13.b

BARREN AND UNCYLTIVATED LAND

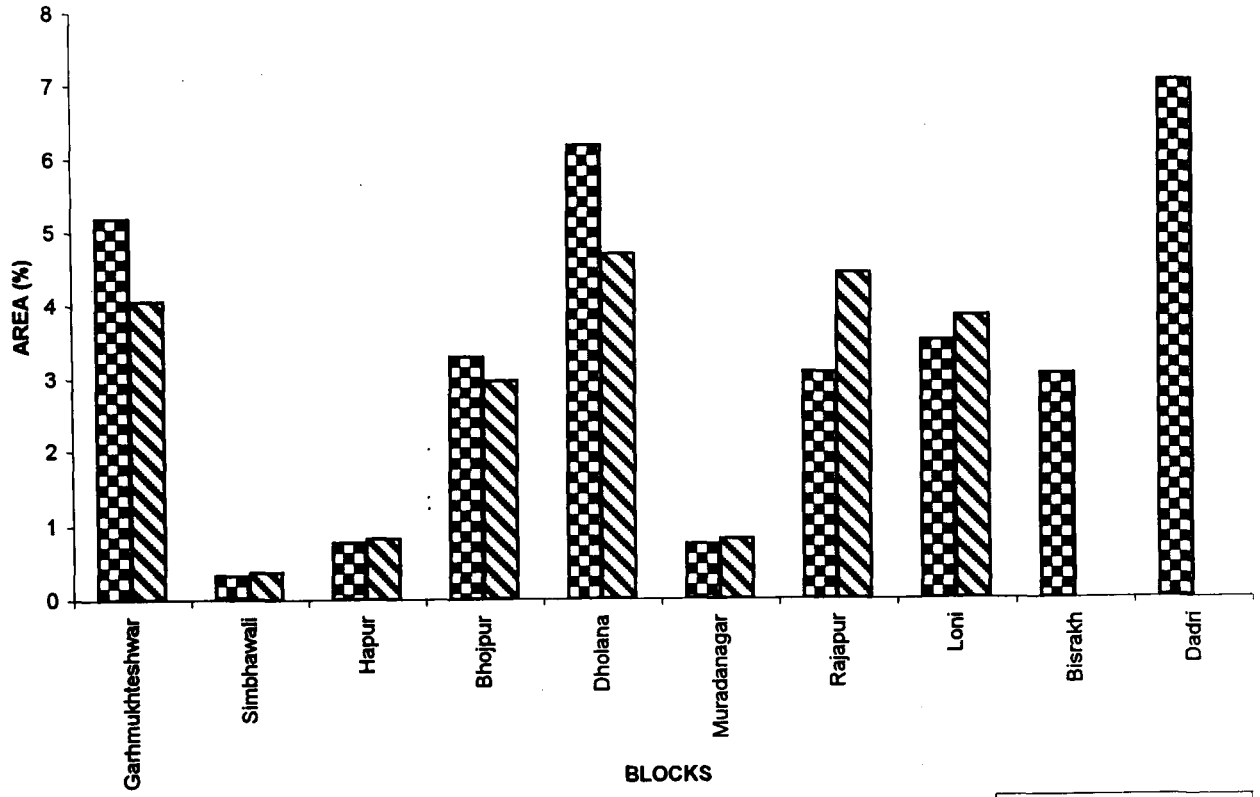


Fig. 13.c

CULTIVABLE WASTE

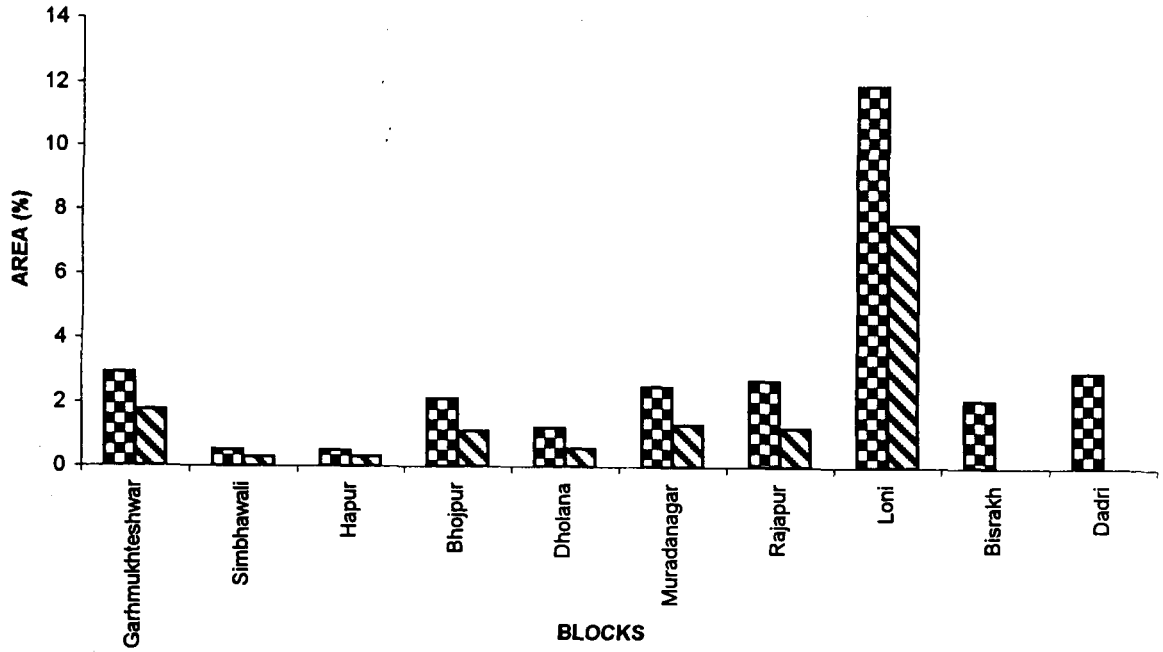


Fig. 13.d

PASTURE AND GRAZING LAND

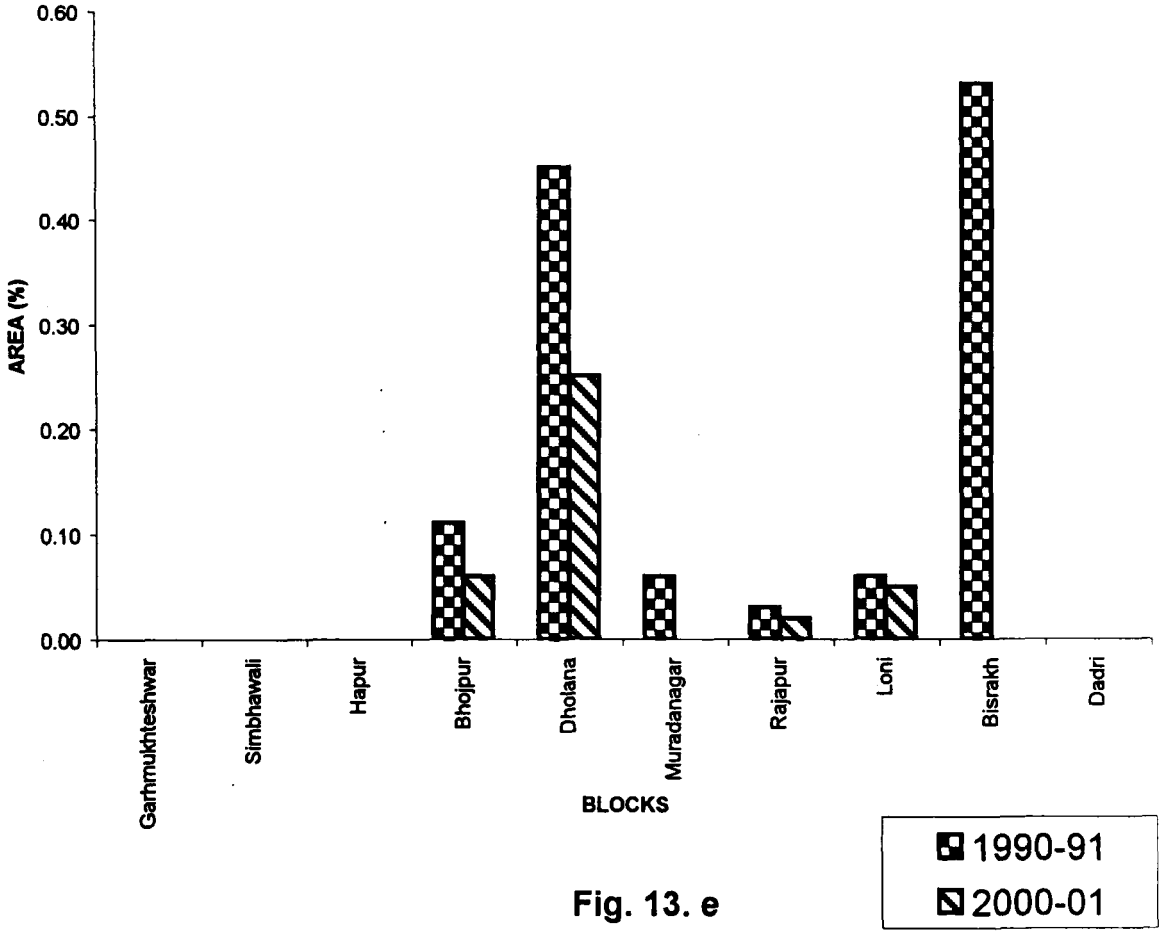


Fig. 13. e

MISELLANEOUS TREES, GROUPS AND SAPS

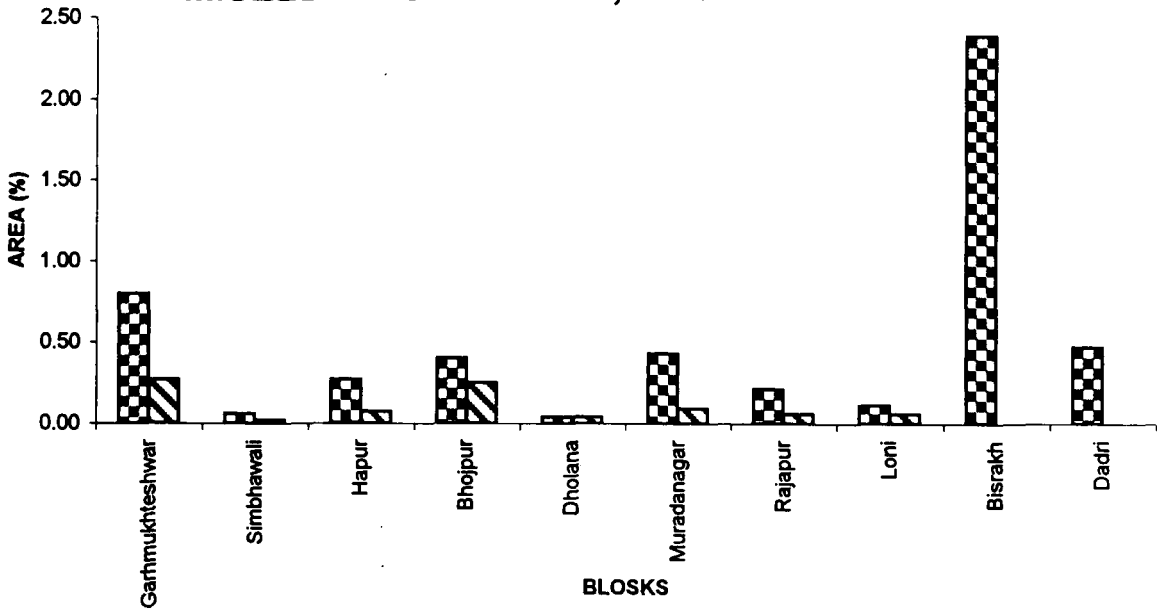


Fig. 13. f

CURRENT FALLOW LAND

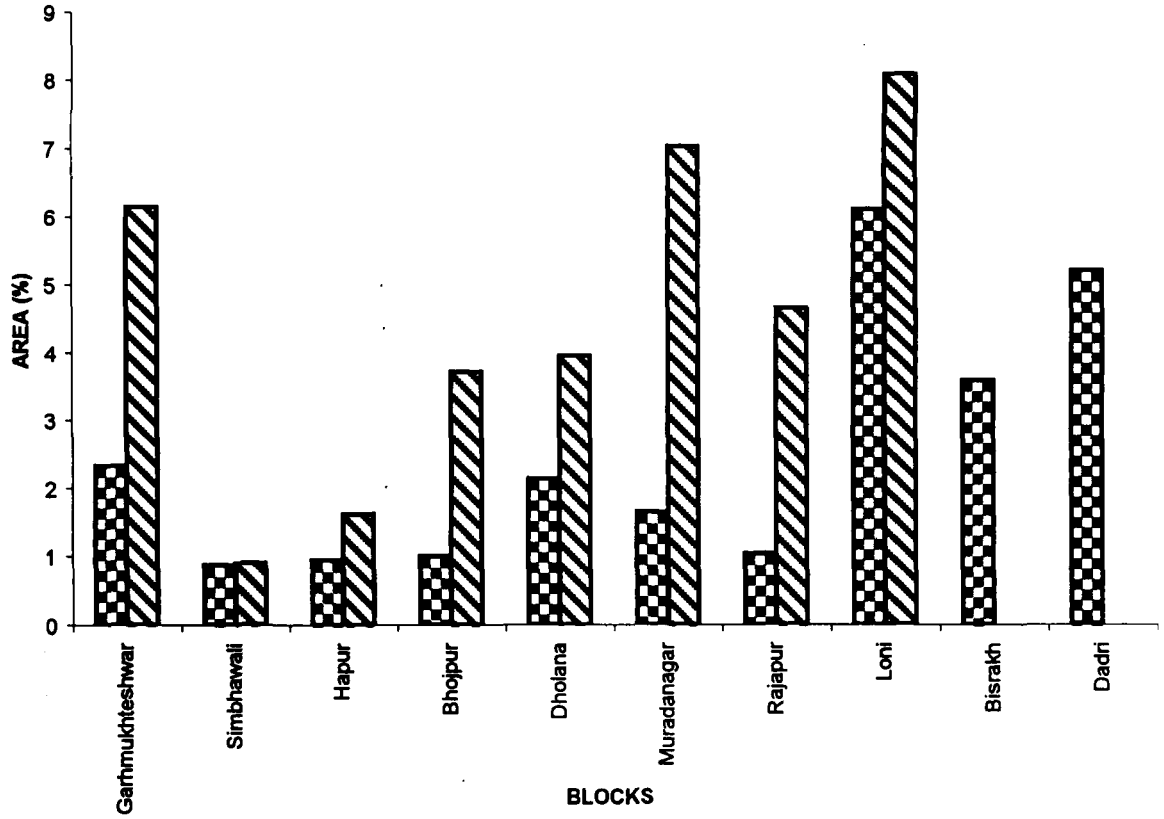


Fig. 13.g

OTHER THAN FALLOW LAND

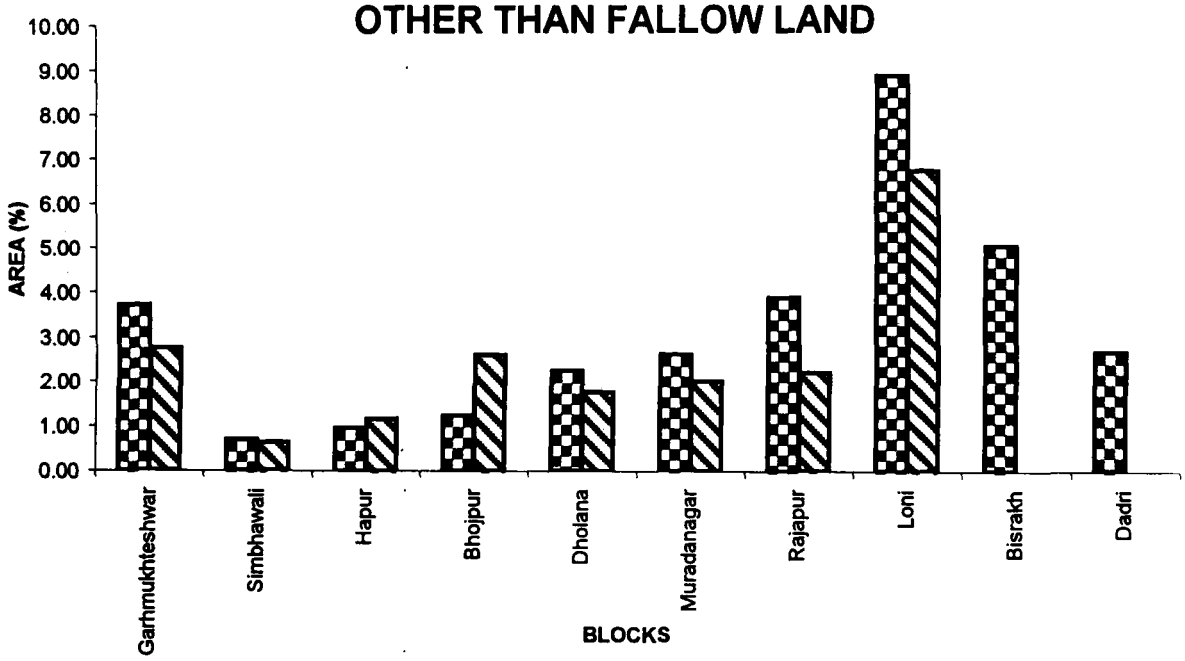


Fig. 13.h

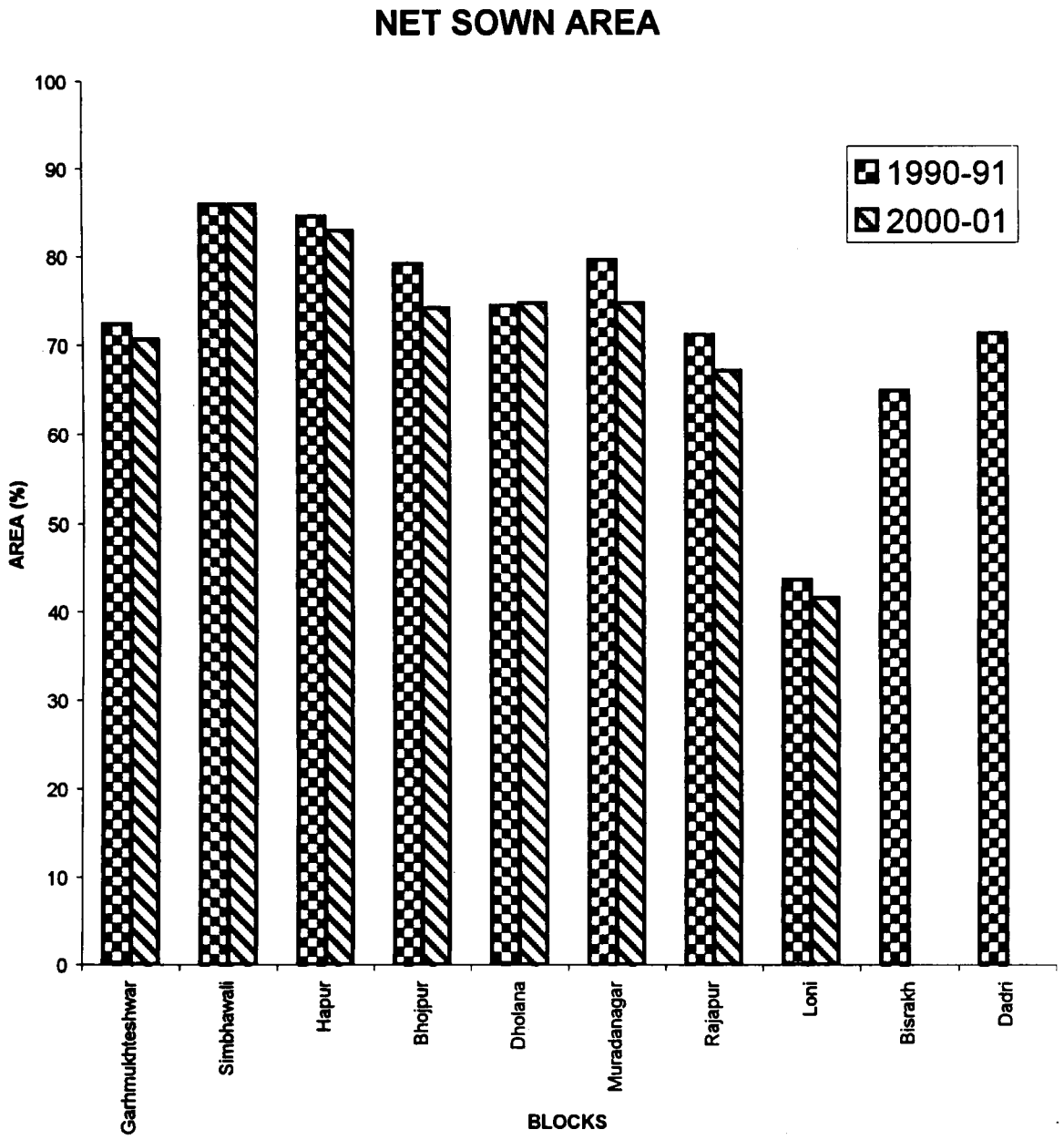

NET SOWN AREA
100
90
80
70
60
50
40
30
20
10
0
AREA (%)
1990-91
2000-01
Garhmukhteshwar
Simbhawali
Hapur
Bhojpur
Dholana
Muradanagar
Rajapur
Loni
Bisrakh
Dadri
BLOCKS

Fig. 13.i

has slightly decreased in each blocks of Ghaziabad district. From Fig No. 13.a to 13. i, bar graph shows the blockwise landuse pattern of Ghaziabad district.

SPATIAL DISTRIBUTION OF LANDUSE

Based upon the satellite data IRS –IB, Liss- II, dated 24th Nov, 1997, a landuse map has been prepared for the study area on 1: 50,000 scale which is reduced to 1:100,000 scale using Survey of India Toposheet as base map and presented in Fig No. 14. The delineation of landuse categories is based upon the standard landuse/ landcover classification developed by National Remote Sensing Agency (NRSA, Hyderabad). The landuse / land cover classes are given below :

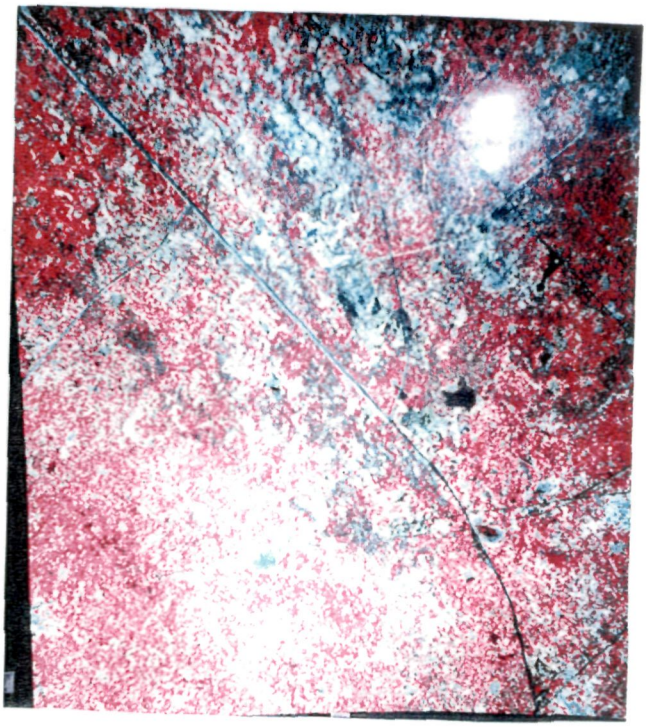
Table - 10

Landuse / Landcover classfication

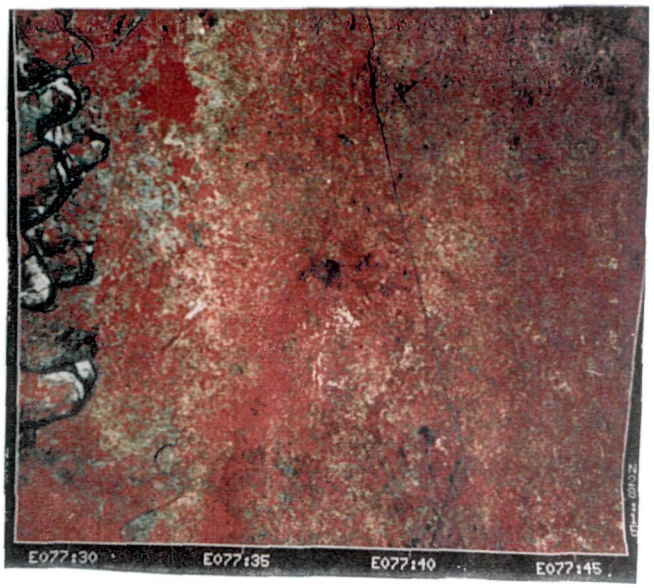
S.No	Land Use / Land Cover Classes		Symbol No.
	Level I	Level II	
1	Built up area	Town / Cities	1
		Villages	2
2	Agriculture	Double crop	5
		Fallow land	6
		Agricultural Plantation	7
3	Forest/ Vegetation	Dense	10
		Open	12
4	Wastelands	Salt affected	16
		Water logged	17
		Marsh	18
		Land with/ without scrub	20
		Industrial Waste	23
5	Water bodies	Pond/ tank	25
6	Others	Grass lands	28

Source : National Remote Sensing Agency (NRSA, Hyderabad), 1996.

Satellite Images of Ghaziabad District



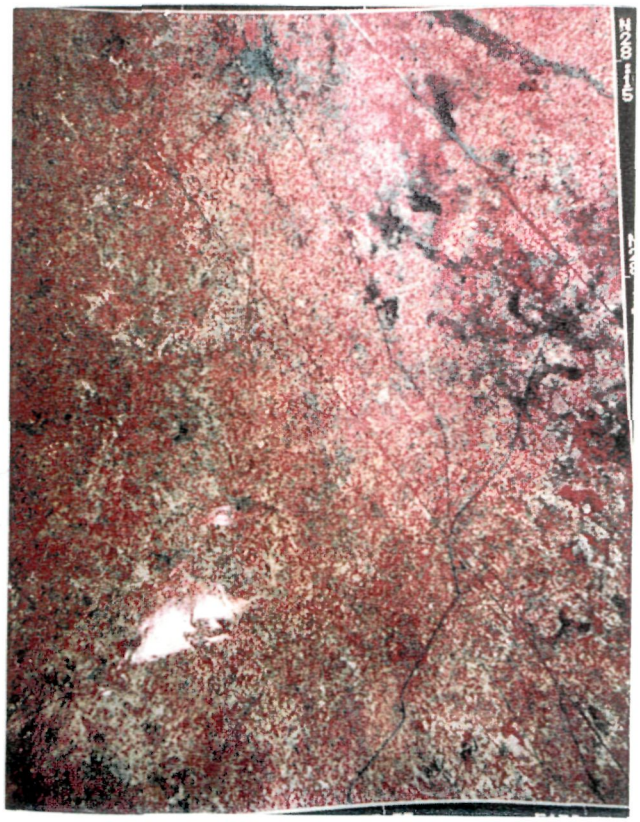
Upper Ganga Plain



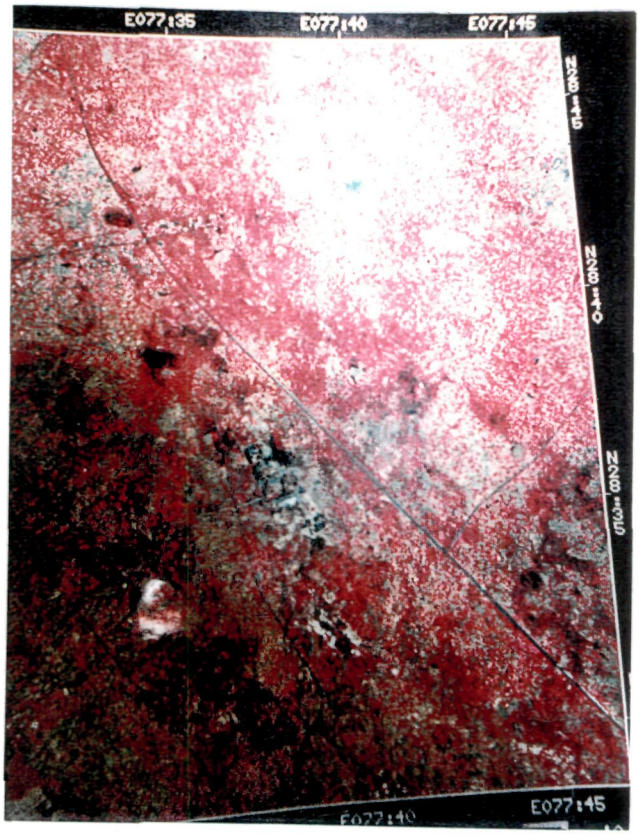
Hindon River

Fig. 14

Satellite Images of Ghaziabad District



Kali Nadi



Part of Upper Ganga Plain

BUILT UP AREA

It is defined as an area of human habitation. It has a number of dwellings road network in other words a group of houses in regular shape. Urban and rural villages are two categories of Built- up area which are shown by symbol No.1 and 2 in the Map respectively. Ghaziabad city is the largest urban centre in this district. The city is situated both sides of Hindon river. Major town are is in the eastern side of the river. Two National Highway (GT road and NH- 24) are bifurcating from this town. This city is also district Head quarters. Main Delhi- Howrah (Electrified) railway line and two other connecting railway lines (one going to Moradabad via Hapur and other going to Dehradun via Meerut) are also passing through this town. The city is expanding very fast. Northern part of the trans Hindon area is mainly residential and southern part is a mix- up of residential and industrial both. Sahibabad industrial belt is quite famous for big industrial establishment.

Besides the old urban town housed within the four walled gates (Jawahar Gate, Sihani Gate, Delhi Gate and Dasna Gate) the rest of the town is extensively planned and spread housing residential sectors. Such as Kavi Nagar, Nehru Nagar, Shastri Nagar, Raj Nagar, Kamla Nehru Nagar, Sanjay Nagar and Model town and Vijay Nagar are the main residential sectors.

Bulanshahr road industrial area and Kavi Nagar Industrial area are adjoining industrial sectors in the south- eastern side of the town whereas Meerut road industrial area is mainly extended along the Meerut road. Large size industrial sectors are seen over the satellite imagery of this area. Planned residential areas, industrial areas, congested and old town area, unplanned colonies without good civic infra-structure. All may be easily identified on the image and are mapped.

Besides the Main City of Ghaziabad, the other medium towns of the district are Hapur, Modinagar and Garhmukhteshwar which are also the tehsil Headquarters. Hapur is a famous grain *mandi* of western Uttar Pradesh and has many ware houses and Godown for foodgrain storages. Modinagar is a town of linear shape stretching to an extent of 8 km along the main road. Modinagar was basically established by Modi Groups of Industries. The industrial set up by the Modi's are either closed down or just working. Garhmukteshwar is situated on the banks of river Ganga and this town is being developed by the Government as a religious place on the pattern of Haridwar, after the division of Uttar Pradesh and Uttaranchal. Other small towns of the district are Pilakhua, Bhojpur, Muradnagar, Loni, Dholana, Simbhawali and Dasna etc. National Thermal Power Corporation (NTPC) mini township has also been developed in the district on an extensive patch of salt affected land near Dholana, Bajhera Khurd, Karanpur Jatta, Parpa, Bhawa, Churiyah, Sare, Masuri, Dasna, Khera and Sikhera villages.

VILLAGES

The entire district Ghaziabad is densely populated as evidences from the well distributed network of villages of various sizes. The dominance occupation of the people in the villages is agriculture. More than 90% of the agriculture is double cropped area. Being in the neighbourhood of Delhi metropolis the district also grow Jaid crop. So there is direct bearing of agricultural development upon the spatial distribution of village settlements. The villages locations are shown in the Map by mapping symbol No.2. Almost all the villages are well connected by matelled road.

AGRICULTURAL LAND

Three categories under agriculture have been delineated in the satellite imagery. Double cropped area are shown by mapping symbol No. 5. Fallow lands (mainly current fallow) by Mapping symbol No. 6 and Agricultural Plantation (Orchard) by symbol No.7. It is observed that almost every inch of land is being utilized in the district due to growing pressure of population for more food and growing needs for more land for human settlements and industrial development. The better source of irrigation (canal network, Tubewells and Pumping sets) have accelerated the pace of overall development of the area and its major impact is observed on agriculture. It is resulted that more than 70% of total area of the district is under agriculture. The area under in agricultural plantation is reported 0.14% while 4.52 % under fallow land during 2000-01. The overall look on the land use/ land cover map of the district leaving aside the human habitation, reflects the entire district under agriculture. Only very few patches are marked showing other categories of land use.

FOREST

Although the entire district is with full of green cover in terms of scattered / organized, avenue and plantation vegetation, but the area under Reserved or Protected forest cover in the district is rather negligible. An Linear type patch of forest is marked along the river Ganga in Garmukteshwar tehsil. The rest of the forest lands are open and very few. The two type of forest categories, i.e. Protected Forest (PF) and Open Forest are shown in the Map by mapping symbol No.10 and 12 respectively.

WASTELANDS

Stamp defines the wasteland as the land which has been previously used but now abandoned and no further use has been found for such land (Stamp, L.D., 1948).

Only culturable wasteland categories are marked in the district. These sub categories of wasteland are given below.

1. Salt affected lands
2. Waterlogged lands
3. Marsh
4. Lands with or without scurb
5. Industrial wastelands (Brick klin)

Salt affected lands are shown in the Map by symbol no. 16. Most of the area in this category is found near Rajpur, Dholana and Upper Ganga Canal in Ghaziabad district. Between Upper Ganga Canal and Dasna distributary in Dholana block shows large area under this category near villages such as Goland Fazainagar, Bajhera Khurd, Karanpur Jatta, Bhawa and Parpa. Whereas in Rajpur block it is found near Matiala village. Some scattered patches are found near Muradnagar block Jalalabad distributary and Niwari and Sare village in Modinagar tehsil.

On the other hand waterlogged areas are shown by the symbol no. 17. Most of the area are in Garhmukteshwar block which account 6.24% in Ghaziabad district. Rest of block contain almost neglible area under this category. Fig. 15 shows that waterlogged areas are also found near Ganga river and scattered patches observed throughout the district. Between Garkmukteshwar distributary to Anupshahr branch (Upper Ganga Canal), villages includes near

Rasulabad, Hashupura, Bajghat, Sheerpur, Badshana, Dholpur and Dahan. Some patches are found near Muradabad, Jalabad village and Qadirabad drain.

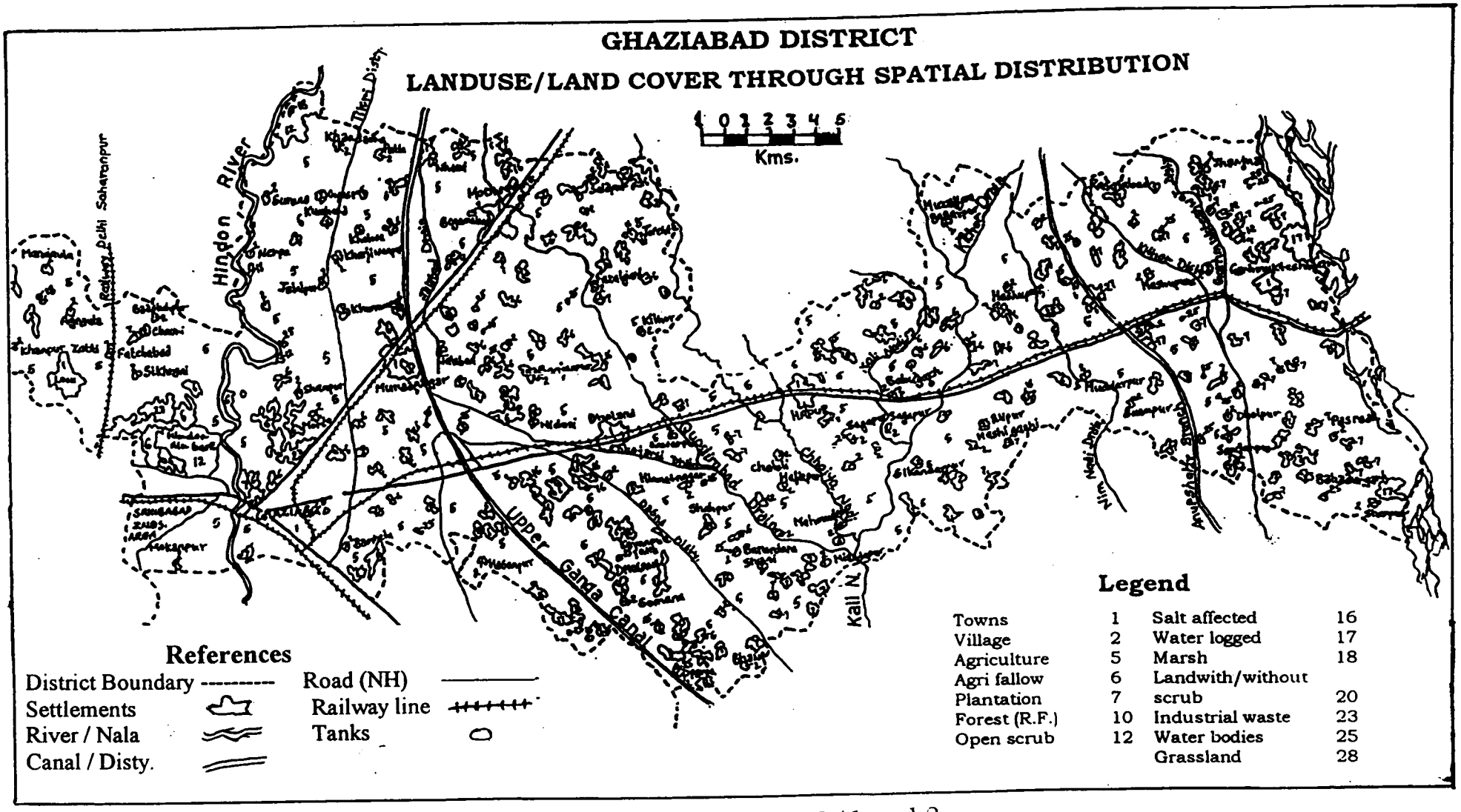
Marshy land and land with or without scurb is shown in the Map by symbol no.18 and 19 respectively. Marshy land are very less scattered near Hindon river and village Nirpa is Muradnagar block whereas land with or without scrub found near Churiyah in Modinagar tehsil.

Industrial wastes are shown in the map by symbol no. 23 in Fig. No. 15. Industrial waste are those which come out from industries in the form of gases and chemical which affect the environment as well as agricultural land by reducing its soil fertility and crop quality. The area which include in this category are Ghaziabad tehsil (Shahibabad Industrial Area), Muradnagar block, Modinagar tehsil which marked as highly urbanized and industrialized region of Ghaziabad district.

WATER BODIES

Although there is not large water bodies (reservoir or lake) delineated in the land use Map of the district but small village ponds and tanks which are bigger than 2-3 hectare (0.25 × 0.25mm) are marked in the satellite imagery. Then water bodies are shown in the map by symbol No. 25. The ponds and tanks are mostly found adjoining the village settlement but they are becoming day by day smaller and shallower in depth resulting drastic reduction in the ground water level of the district.

Then village ponds were the unseperable part of rural habitat and part and parcel in the maintaining the ecological environment of the village. Besides the water harvesting, the village ponds were very much useful fulfilling the village needs of animal drinking, habitat



Source: Survey of India, Toposheet No. 53 H/5,6,9,10,13,14, 53 L/1 and 2.

Fig. 15

restoration, etc. But these ponds are shrinking and from most of the villages either these common property lands have been encroached or disappeared. Besides, these ponds and tanks, the other water bodies have also been mapped which are linear in nature like canal and distributaries. These linear features are easily identified on imagery. The land use / land cover map of the district is presented as Fig. No. 15.

LEVEL OF AGRICULTURAL DEVELOPMENT

This district is one of the most prosperous, agriculturally developed, highly irrigated and fertile part of western U.P. It is the seat of green revolution. Farmers of this region are well aware of the use of irrigation and with the advent of high yielding of seeds as they are using irrigation facility judiciously. Inspite of this there is marked variation in the level of agricultural development.

The district consists of eight community development blocks in 2000-01 viz. Bhojpur, Muradnagar, Rajapur, Loni, Dholana, Hapur, Shimbhawali, Garhmukteshwar. Whereas in 1990-91, there were ten community development blocks which includes Dadri and Bisrakh. In order to assess the level of agricultural development at block level nine indicators has been taken. The indicator reflect the development which has taken place during the last ten years in agricultural sector taking the year 1990-91 to 2000-01.

The data has been analysed by calculating the Z- score of all the nine indicators averages and grouped into three variables (I) Agricultural condition, (ii) Agricultural infrastructure, (iii) Agricultural production, which has give some weightage as mentioned in the methodology. So, in order to asses the level of agricultural development the groups averages has been multiplied with the respective weightage which has been added together and divided by 3 which gives composite index of each block respectively (Table no. 11-14).

Table-11

Composite Z-score of Ghaziabad district (1990- 91)

	Agricultural condition				Agricultural infrastructure				Agricultural productivity
BLOCKS	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
GARHMUKHTESHWAR	0.04	1.07	0.15	2.82	1.04	1.80	0.38	0.35	0.94
SIMBHAWALI	1.19	0.81	1.12	0.57	0.98	1.60	1.07	2.43	0.05
HAPUR	1.09	0.75	2.37	0.57	1.72	0.20	0.85	1.07	1.63
BHOJPUR	0.62	0.04	0.19	0.57	0.88	0.50	0.00	0.21	0.33
DHOLANA	0.18	1.29	0.49	0.57	1.14	0.20	1.84	0.08	0.34
MURADNAGAR	0.32	0.80	0.40	0.11	1.01	0.10	0.76	0.65	0.72
RAJAPUR	0.00	0.70	0.80	0.51	0.50	0.60	0.85	0.53	1.14
LONI	2.46	0.58	0.73	0.59	0.77	1.60	1.00	0.52	1.98
BISRAKH	0.91	2.09	1.16	0.26	0.66	0.90	0.77	1.12	0.63
DADRI	0.07	0.45	0.37	0.18	0.92	0.30	0.31	0.72	0.27
TOTAL GHAZIABAD	0.68	0.85	0.77	0.67	0.96	0.78	0.78	0.85	0.80

X_1 = percentage of net sown area to total area
X_2 = intensity of cropping
X_3 = consumption of fertilizer per hectare
X_4 = percentage of net irrigated area to net sown area
X_5 = number of energized pumpset per 1000 hectare Of net sown area
X_6 = average size of the land holding
X_7 = number of agricultural marketing center per 1000 hectare of net Sown area
X_8 = number of tractors per 1000 hectare of net sown area
X_9 = Average size of foodgrain per hectare of net sown area

Table-12

Composite Z-score of Ghaziabad district (2000- 01)

	Agricultural condition				Agricultural infrastructure				Agricultural productivity
BLOCKS	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
BHOJPUR	0.09	0.37	0.25	0.17	0.05	0.28	0.17	0.75	0.03
MURADNAGAR	0.31	0.61	0.21	1.16	0.03	1.00	0.75	0.80	0.00
RAJAPUR	0.29	0.79	0.04	2.33	0.19	0.86	0.67	0.69	1.09
LONI	2.33	0.36	1.31	0.33	0.07	1.14	1.00	0.66	1.91
DHOLANA	0.30	1.61	1.18	0.83	1.71	0.28	2.08	0.34	0.12
HAPUR	0.97	0.83	0.36	0.33	1.97	0.14	0.75	0.91	1.29
SHIBHAWALI	1.15	1.11	2.10	0.33	0.53	1.43	1.08	2.21	0.42
GARHMUKHTESHWAR	0.11	1.49	0.47	1.33	0.93	1.57	0.83	0.14	1.13
TOTAL GHAZIABAD	0.69	0.89	0.74	0.85	0.68	0.83	0.91	0.81	0.74

X_1 = percentage of net sown area to total area
X_2 = intensity of cropping
X_3 = consumption of fertilizer per hectare
X_4 = percentage of net irrigated area to net sown area
X_5 = number of energized pumpset per 1000 hectare Of net sown area
X_6 = average size of the land holding
X_7 = number of agricultural marketing center per 1000 hectare of net Sown area
X_8 = number of tractors per 1000 hectare of net sown area
X_9 = Average size of foodgrain per hectare of net sown area

Table-13

Indices of Agricultural Development (1990- 91)

BLOCKS	Agricultural Condition	Agricultural Infrasturcture	Agricultural Productivity	Composite Index
GARHMUKHTESHWAR	1.63	1.07	0.28	0.99
SIMBHAWALI	1.48	1.82	0.02	0.11
HAPUR	1.91	1.15	0.49	0.18
BHOJPUR	0.57	0.48	0.10	0.38
DHOLANA	1.01	0.98	0.10	0.69
MURADNAGAR	0.65	0.76	0.22	0.54
RAJAPUR	0.80	0.74	0.34	0.63
LONI	1.74	1.17	0.59	1.17
BISRAKH	1.77	1.01	0.19	0.99
DADRI	0.42	0.67	0.08	0.39
TOTAL GHAZIABAD	1.18	1.01	0.24	0.81

Level of Agricultural Development

CATEGORIES	INDEX RANGE	NO. OF C.D.B	NAME OF C.B.D.
HIGH	>1.00	3	Loni, Shimbhawali, Hapur
MODERATE	1.00 - 0.50	5	Garmukteshwar, Rajapur, Dholana, Muradnagar, Bisrakh
LOW	< 0.50	2	Bhojpur, Dadri

Table-14

Indices of Agricultural Development (2000-01)

BLOCKS	Agricultural Condition	Agricultural Infrasturcture	Agricultural Productivity	Composite Index
BHOJPUR	0.35	0.37	0.01	0.24
MURADNAGAR	0.92	0.77	0.00	0.56
RAJAPUR	1.38	0.72	0.33	0.81
LONI	1.73	0.86	0.57	1.05
DHOLANA	1.57	1.32	0.04	0.97
HAPUR	0.99	1.13	0.39	0.84
SHIBHAWALI	1.88	1.57	0.13	1.19
GARHMUKHTESHWAR	1.36	1.04	0.34	0.91
TOTAL GHAZIABAD	1.27	0.97	0.22	0.82

Level of Agricultural Development (2000-01)

CATEGORIES	INDEX RANGE	NO. OF C.D.B	NAME OF C.B.D.
HIGH	>1.00	2	Loni, Shimbhawali
MODERATE	1.00 - 0.50	5	Garmukteshwar, Rajapur, Dholana, Muradnagar, Hapur
LOW	< 0.50	1	Bhojpur

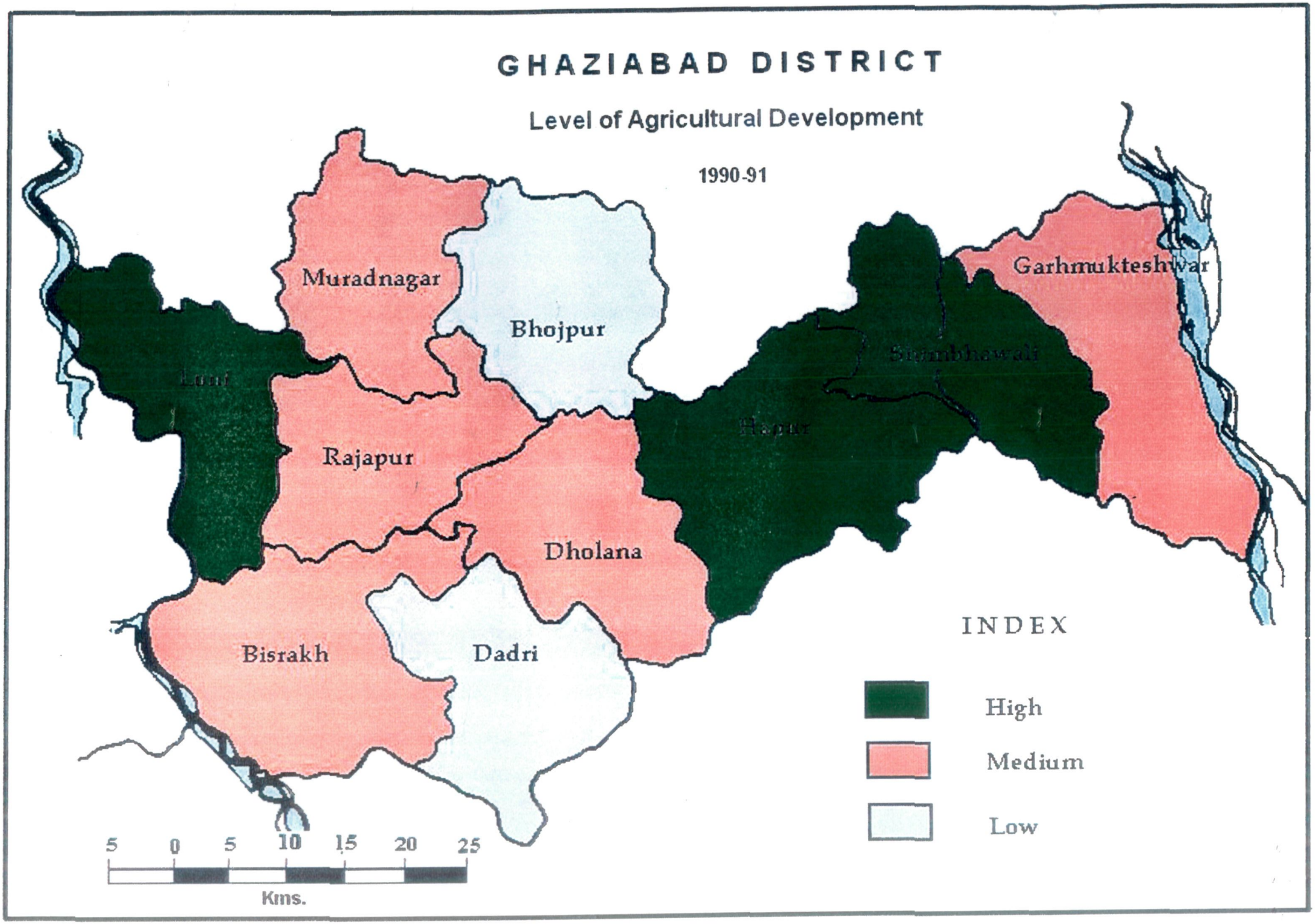
REGIONS OF HIGH LEVEL OF DEVELOPMENT

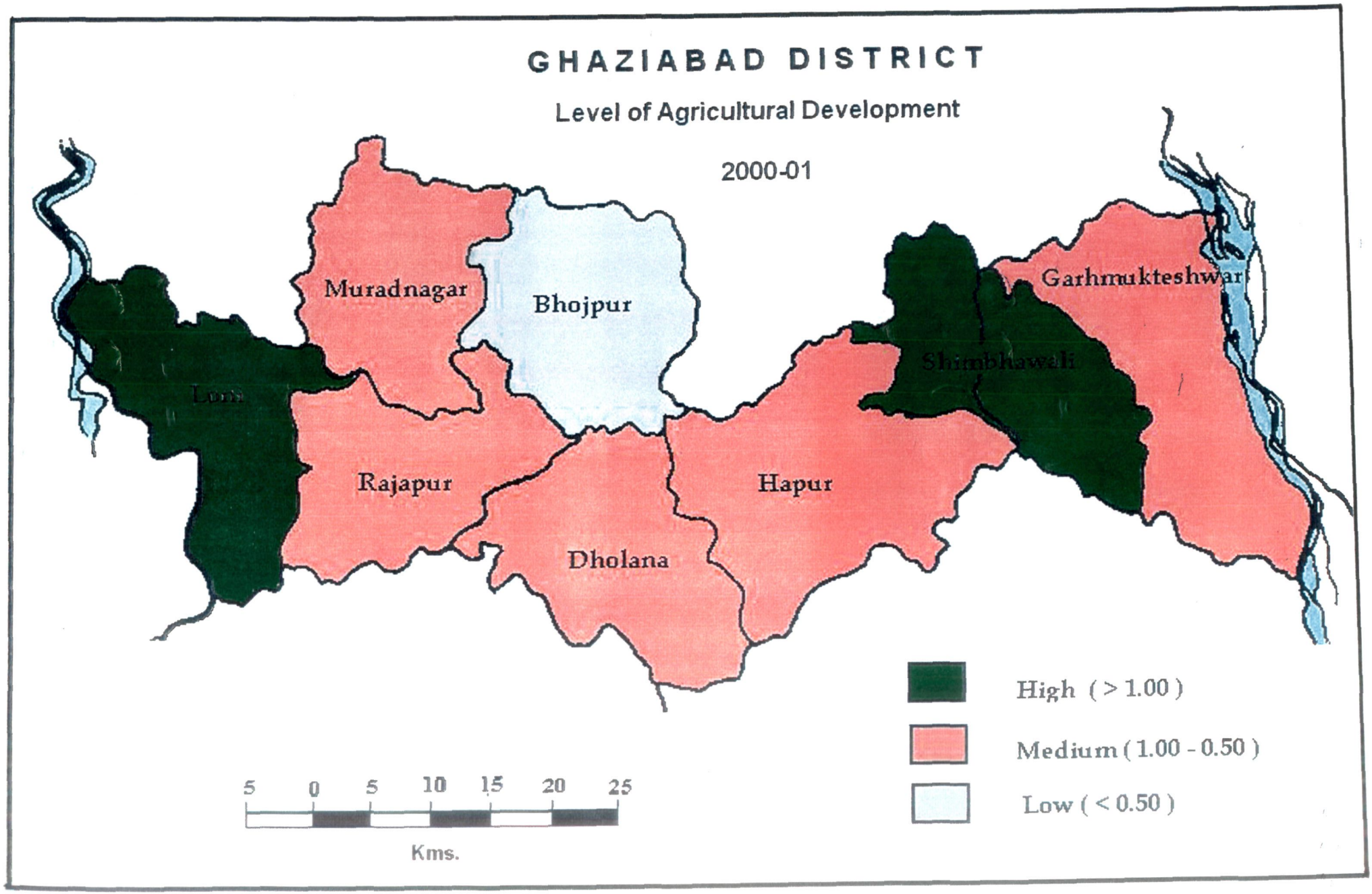
In Ghaziabad District, the region with a composite index of more than 1.00 includes Loni (1.01) and Shimbhawali (1.15) blocks in 2000-01. Whereas, in 1990-91, it includes the Loni (1.14), Hapur (1.14) and Shimbhawali (1.09). During this decade Hapur has been variated from High to Moderate level of agricultural development because of tremendous decrease in consumption of fertilizers which goes from 2.37 to 0.36 per 1000 hec. and low agricultural productivity. Loni is considered to be one of the developed urban center having good agricultural infrastructure but act as good market center of Ghaziabad district. As Loni falls in high category, the agricultural condition and agricultural infrastructure show high development and moderate agricultural productivity during 1990-01 to 2000-01. Data show the major increase in consumption of fertilizers and average yield of foodgrains per 1000 hec. And rest of the indicators shows slight decline during 2000-01. On the other hand Shimbhawali show high agricultural condition and agricultural infrastructure and low agricultural productivity. During 1990-91 to 2000-01 data shows a major increase in net irrigated area which reflect the high agricultural infrastructure and agricultural condition.

REGION OF MODERATE LEVEL OF DEVELOPMENT:

This region having a composite indices range between 0.50 and 1.00 cover Garhmukteshwar (0.99), Rajapur (0.63), Dholana(0.69), Bisrakh(0.99), Muradnagar(0.54) in 1990-91. Whereas, it includes Garhmukteshwar (0.91), Rajapur (0.81), Dholana(0.97), Muradnagar (0.56) and Hapur (0.84)in 2000-01 in Ghaziabad District. Garhnukhteshwar has a high level of agricultural condition and agricultural infrastructure and low level of agricultural productivity during 1990-91 to 2000-01. A close scrutiny of indicators shows that

a slight increase of net sown area , consumption of fertilizers and net irrigated area brought up the agricultural condition of this block. Whereas, due to major decline in average size of land holding has brought down the agricultural infrastructure during 1990-91 to 2000-01. In Rajapur block, agricultural condition has been variated from moderate to high due to major increase in net irrigated area (0.51 to 2.33) and decline in consumption of fertilizer (0.80 to 0.04). Whereas, agricultural infrastructure and agricultural productivity falls in moderate category. Dholana also comes in moderate category which shows high level of agricultural conditions and variate from moderate to high level of agricultural infrastructure during 1990-91 to 2000-01. Data shows, a major increase in consumption of fertilizer and net irrigated area which reflect the high level of agricultural condition of this block. Whereas due to increase in number of agricultural market centers and number of tractors during 2000-01, the agricultural infrastructure fluctuate from moderate to high. Bisrakh also falls in moderate category during 1990-91 which recently gone to Gautam Budh Nagar district. It shows high level of agricultural condition and agricultural infrastructure and low agricultural productivity due to high consumption of fertilizer and cropping intensity. Hapur has been variated from high to moderate level of development during 2000-01 because of slight decline in net sown area, average size of land holding and consumption of fertilizer per 1000 hectares. Whereas, Muradnagar block shows a moderate level of agricultural infrastructure having low productivity. The reason behind this is that, it comes in industrial category and most of the agricultural land has been utilized for non- agricultural uses(build up area and commercial industrial purposes). Data shows that due to increase in net irrigated area and average size of land holding the block comes in moderate category during 2000-01.


GHAZIABAD DISTRICT
Level of Agricultural Development
1990-91
Muradnagar
Bhojpur
Loni
Rajapur
Dholana
Bisrakh
Dadri
Hapur
Sambhawali
Garhmukteshwar
INDEX
High
Medium
Low
5 0 5 10 15 20 25
Kms.


GHAZIABAD DISTRICT
Level of Agricultural Development
2000-01
Muradnagar
Bhojpur
Garhmukteshwar
Shimbhawali
Loni
Rajapur
Hapur
Dholana
High (> 1.00)
Medium (1.00 - 0.50)
Low (< 0.50)
5 0 5 10 15 20 25
Kms.

REGION OF LOW LEVEL OF DEVELOPMENT

The community development blocks i.e. Bhojpur and Dadri falls under this category with composite indices 0.38 and 0.39 during 1990-91, whereas in 2000-01 it include only Bhojpur block having composite indices 0.24. Bhojpur block shows low level of agricultural condition, infrastructure and producitivity during 1990-91 to 2000-01, but in case of agricultural condition it variated from moderate to low (0.57 to 0.35) due to decline in net sown area, cropping intensity and consumption of fertilizers with a slight increase in net irrigated area. Whereas, rest of the indicators shows declination during this decade. On the other hand, Dadri block which was earlier a part of Ghaziabad district during 1990-91 shows the low level of agricultural development. The agricultural condition and productivity is low but the agricultural infrastructure (0.67) shows moderate level due to increase of number of pumpsets and tractors in this region.

Fig No. 16 and 17 shows at block level, the level of agricultural development during 1990- 91 and 2000-01 in Ghaziabad district.

CONSUMPTION OF FERTILIZER

Fertilizer is the key input for increased crop production. The consumption of fertilizer has been drastically increased during the green revolution (1968) which increased the food production and made self- sufficient in the production of foodgrain. The consumption of fertilizers is determining by availability of assured irrigation, high yielding variety of seeds, better economic conditions of the farmers social awareness and high literacy rate. The consumption of fertilizer is based on the deficiency of nutrients and availability of water. Soil fertility loose is nutrients by continuous cultivation and replenish to a great extent by re- supplying nitrogen in the soil through the use of

fertilizers and subsequently enhance the agricultural productivity per unit area.

The annual report of FAO states the use of fertilizers as a "spreadsheet of agricultural development" because wherever efforts are made to raise agricultural efficiency and production for fast increasing population, more fertilizer and manures have invariably needed. Perhaps, even more important to many soils they make possible good yields of valuable crops that would not grow at all without them, or would grow more poorly. (Vladimir, I and Harold J.P). Fertilizer also improve the ' biological quality' and make good the losses of essential nutrients continuously taking place due to cropping, leaching and erosion. Infact even if, all the available organic matter is applied back to the soils, there will be a scope of application of fertilizers for maintaining it at high level of productivity from year to year (Roychowdhri, S.P).

Application of higher doses of chemical fertilizer has directly influence on the crop yield atleast upto 100 kg/ ha. In India, the production and consumption of NPK nutrient in 1991-92 were 9.9 and 12.7 million tones. The average fertilizer application in advanced states like Punjab is 167.3 kg/ ha, followed by Andhra Pradesh (137.3 kg/ha), Haryana (123.7 kg/ha) and Tamil Nadu (10.6 kg/ha) while national average of fertilizer consumption is only 73 kg/ha.(Hedge, N.G, 2000). This is because the farmers having irrigation facilities have only been making optimum use of chemical fertilizers and four major crops mainly sugarcane, rice, wheat and cotton consume over 80 % of the total quality of fertilizers used in the country.

N,P and K are known as primary plant nutrients Ca, Mg and S are known as secondary nutrients, Fe, Mn, Cun, Za, B, Mb and Cl. as micro nutrients. The primary and secondary nutrient elements are known as major elements. It has been observed that as against the recommended N:P:K of 4:2:1, Indian farmers have been applying

fertilizer in 8.5: 2.6: 1 ratio which includes initial vegetative growth, susceptibility to pest diseases, lodging, poor floral induction and delayed maturity.

The consumption of fertilizer for both the year 1990-91 and 2000-01 have been clearly shown the variation in the table no. 15- 16.

Table-15

Consumption of Fertilizer (1990-91)

BLOCK	Nitrogen	Potash	Phosphorus	Total (Kg/ha Copped Area
Garhmukhteshwar	74.85	18.45	1.28	94.58
Simbhawali	138.95	34.54	4.33	177.82
Hapur	184.38	45.78	8.91	239.07
Bhojpur	63.15	26.04	2.95	92.14
Dholana	61.96	21.40	1.88	85.24
Muradnagar	95.57	25.51	5.06	126.14
Rajapur	47.86	18.24	1.34	67.44
Loni	32.37	26.77	2.18	61.34
Bisrakh	25.05	10.35	1.08	36.48
Dadri	59.25	30.14	2.55	91.94
Ghaziabad District	84.06	26.03	3.41	113.50

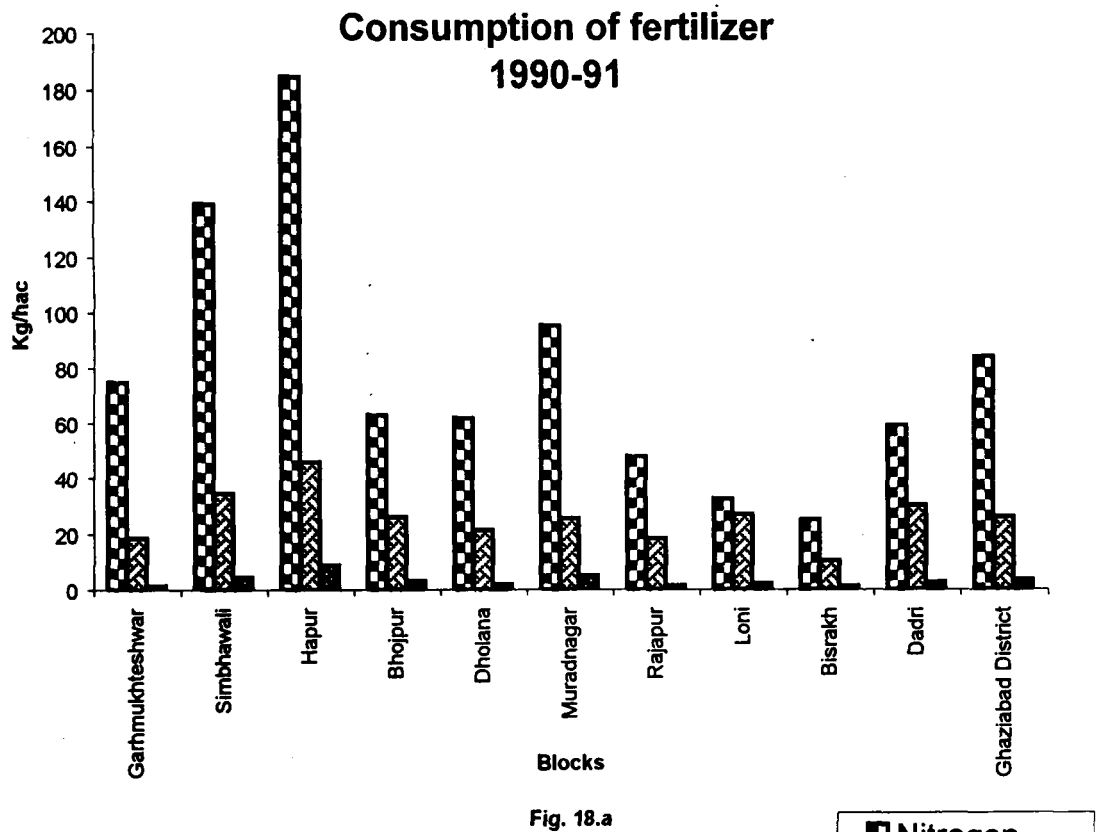


Fig. 18.a

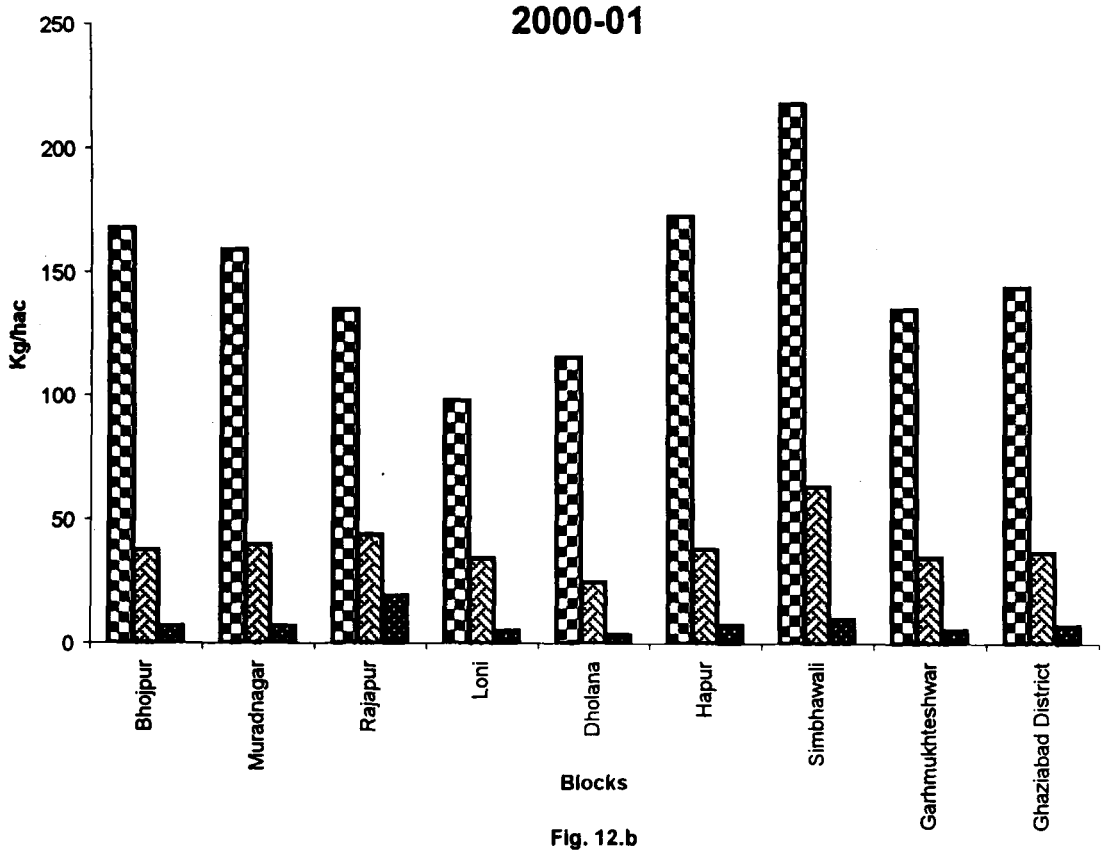


Fig. 12.b

Table-16

Consumption of Fertilizer (2000-01)

BLOCK	Nitrogen	Potash	Phosphorus	Total (Kg/ha Copped Area
Bhojpur	167.67	37.73	6.74	212.14
Muradnagar	158.75	39.63	6.90	205.28
Rajapur	134.83	43.65	19.04	197.52
Loni	97.78	34.33	4.94	137.05
Dholana	115.15	24.52	3.41	143.08
Hapur	171.95	37.92	7.31	217.18
Simbhawali	216.91	63.06	9.74	289.71
Garhmukhteshwar	134.62	34.60	5.31	174.53
Ghaziabad District	143.25	36.34	7.16	186.75

Source : District Statistical Handbook, Ghaziabad District (1990-91 and 2000-01)

The consumption of NPK was maximum in Hapur block (239.07 kg/ ha) in the year 1990-91, whereas in 2000-01 Simbhawali block shown the maximum consumption ie. 289.71 kg/ ha which shows a major variation during this decade. Almost all the blocks shows major increase in the consumption of fertilizer during 2000-01 to increase their productivity and earn maximum profit at less time. Adoption of new technology and chemicals like insecticides, pesticides and herbicides has been used frequently to have maximum growth and productivity. (Fig No. 18.a and18.b)

CHAPTER -VI

CONCLUSIONS AND RECOMMENDATION

Sustainable use of rational sources needs greater attention particularly in rural areas. In agricultural sector it is only possible if the land resource utilization (Soil and Water) is prudent. Concerted effects are urgently needed to sticks a balance between agriculture and geo-ecological environment.

India is known for traditional methods of sustainable agriculture. As farmers are switching over from modern, intensive to an ecologically protective agricultural practices, the scope of organic framing, bio-fertilizers in enhancing bio-productivity of the soil fertility and integrated nutrient supply an important pre-requistic for sustainable agriculture.

Both the parameters related to agricultural development and environmental degradation have been taken into consideration in Ghaziabad district at block level. The analysis has been drawn during the decade 1990-91 to 2000-01 to show the sustainability of agriculture development and on the basis of what the ecological challenges has been facing to agriculture?

Physical factors play an important role for agricultural development. Viz., climate, vegetation and soil on the basis of these factors, conclusion has been drawn to sustain the agricultural developments by maintaining the ecological balance which are very much deteriorated by human beings by applying modern techniques and affecting the crops and its productivity.

It has been observed that forest are almost negligible and occupies only 1.23% of the total geographical area during 2000-01 whereas in 1990-91 it was only 0.99% in Ghaziabad district which

shows slight increase during last one decade. Only Garhmukhteswar block have 989 hectares area under vegetation and some small patches found near Rajapur (727hec.) and Muradnagar block (277hec.). Forest has been exploited due to over urbanisation and industriation. Loni, Muradnagar and Hapur block shows high deterioration of forest. But data shows slight increase due to more emphasis was given on plantation. Government policies has been made to conserve the forests in the district by way of: Firstly, government has restricted to cut the green trees and young plants, secondly, variety of trees which grows rapidly should grow near or along the roads, railway tracks and canals. Thirdly, the areas along the Hindon river, Muradnagar, Garhmukhteswar and Loni block, growth of plantation has increased tremendously as per the government policies are undertaken. This has made the environmental balance more effective by reducing the pollution coming out from the industries.

The area is almost plain and having alluvial soil which is very fertile and productive for crops like wheat, rice, maize, sugarcane etc. On the basis of the area studied it has been concluded that soil fertility has been reduced due to continuous use of chemical fertilizer which adversely affected the physical as well as chemical properties of soil. It deteriorates soil structure and soil texture of the agriculture land. As well as it has been observed that the taste of products also goes on deteriorating by application of chemical fertilities.

Environmental degradation basically related with land and water. Based on data analysis, it may be concluded that the area under high level of environmental degradation includes Hapur and Loni which is 1.05% and 1.00% respectively. The area is very much influenced by soil erosion, ground water depletion in these areas, which are highly agriculturally developed region of this district. Whereas low environmental degradation is found in Bhojpur block

(0.31%) which clearly shows the correlation that higher the level of agricultural development more environmental degradation take place.

Sustainable agricultural development which explains the landuse pattern, agricultural development and consumption of fertilizer of Ghaziabad district at block level during 1990-91 and 2000-01. On the basis of the study area, it concluded that level under non-agricultural land has been increased from 14.36% to 16.26% whereas there is a slight decrease in the net sown area. It was due to the increase in industrial and commercial sectors such as Modinagar tehsil, Muradnagar, and Ghaziabad tehsil (Shahibabad industrial area). To show the sustainable agricultural development, level of agricultural development has been analysed at block level, which shows that area under high category like Loni, Hapur and Shimbhawali having good agricultural condition and infrastructure due to high irrigation facilities and use of chemical fertilizer as well as adoption of new technology for agricultural production. Whereas, in 1990-91 Bhojpur and Dadri comes in low level due to non-availability of inadequate water (drainage system is not properly maintained) which affect the developed of the region. But the current status show slight development in this region as Dadri block has shifted to Gautam Budh Nagar district. The total geographical area has been reduced but it has not affected the productivity.

Analysis has been concluded that environmental degradation, especially land degradation is more affected in the district. As a result of continued mining of soil and over exploitation of water resources, it has reached the environmental consequences at alarming stage. As the study has been done at block level, it shows that ground water level has decreased throughout the district Hapur and Loni comes under Dark block(Ground water level) and contain water level above 75%, whereas Bhojpur and Dholna having 50 to 60 percent. It shows that farmers in this region have over-exploited the agricultural land by growing 2-3 crops at a time and by shifting cultivation which has

ultimately made the water level low during this decade. Problems like water logging, soil erosion, alkaline soil, surface water pollution and extensive use of chemical fertilizers has deteriorated the agricultural land. Water logging is highest in Garhmukteshwar and Shimbhawali block i.e. 6.24% and 2.70% respectively. Whereas soil erosion is maximum in Dholana block (3.49%) in Ghaziabad district. On the other hand, salt affected areas includes Rajapur and Dholana blocks which shows that the drainage system is not properly maintained in Garmukhteshwar block. Since Dholana block comes in Hapur tehsil it shows the growth of industrialization and urbanisation which ultimately affected the soil fertility and leads to soil erosion as well as made the ground water level low and saline.

Strategies for sustainable Agriculture development

By manipulating the forces of nature to meet the growing needs, man has made agriculture growing hard bountiful but excessive exploitation caused environment unfriendly and degenerating. The manipulation and exploitation of natural resources led to serious damages to environment owing to cutting down the forest, destroying bio-diversity, indiscriminate use of chemical fertilizer and crop protection, degradation of soil fertility and productivity, pollution of air and water, depletion of ozone layer, global warming and acid air.

The strategies suggested for a high level of crop production to meet the challenge of the future demand. It ensures friendly and healthy environment as Indian economy is based totally on agriculture. A two way approach is required, (i) to solve the rural problems through development process and (ii) to protect environment through community participation by creating awareness among them.

1. Ghaziabad district having very negligible area under forest and there is need for sustainable forestry so that forestry should enter into a dynamic and productive phase. Afforestation schemes has to be introduced for the conservation of forest

resources. The permanent fallow land patches and wasteland area should be converted into plantation areas on the pattern of Hindon track where a patch of wasteland is converted into forest area. Industrial areas like Loni, Muradnagar, Modinagar, Hapur, producing harmful gases through industries and industrial wastes which is affecting the soil and crop productivity and environment. So to reduce the environmental degradation more emphasis should be given on plantation along with the roads and railways. To fulfill the needs of local people, pattern of agro-forestry and social forestry should be encouraged in these areas.

2. Climate also influence the agricultural land and crops. As rainfall is uncertain and temperature also varies from season to seasons, farmers used to grow crops according to climate which are favourable for different crops. Such areas which are near to Delhi like Loni block and Ghaziabad tehsil (especially Shaibabad industies area) temperature is quite high due to its location whereas, Modinagar, Hapur and Garhmukteshwar climatic conditions varies accordingly. Hence, proper understanding of agro-climatic relation through crop weather conditions soil and water management and thus evolving an appropriate cropping pattern based on regional resource potential must be emphasized.

3. Environmental degradation specially land degradation where ground water in poor quality, provision of drainage is the most effective and financially feasible. Sub-surface drainage along with appropriate crops and agro-economic and cultural practice will create favourable conditions for crop production in areas like. Hapur, Loni and Shimbhawali where ground water level and water logging problem is quite high.

4. Ground water level has decreased throughout the district due to over exploitation of water. Basically, ground water is used for drinking and irrigation purposes in the district. But due to low level, there is a lack of purified water for drinking and irrigation which is a basic need for the development of sustainable agriculture. So, to increase the ground water level in Hapur and Loni (Dark blocks), having water level below 65% government should make the policy for maintaining the water level. Boring which are failed or not working should be repaired. Tubewells and canals should be properly maintained. Drainage system which is a part of irrigation should also be taken into consideration. Water quality should be improved by establishing the treatment plants in those highly urbanised areas. The quality of water is highly degraded near Kali Nadi, as well as where the industries are growing rapidly in Muradnagar Hapur, Loni, Shahibabad industrial area in Ghaziabad tehsil, Garhmukteshwar block.

5. Surface water has lead to the problem like water logging and salinity. In Ghaziabad district Garhmukteshwar block (6.24%) is highly affected by water logging. So, to overcome the problem proper drainage system should be made by government or by Municipal Corporation. Broken roads and areas which are filled with water and looks like small ponds should be prepared and maintained.

6. Due to the use of high doses of chemical fertilizers, insecticides and pesticides over crops in agricultural land, it has decreased the productivity as well as the quality of soil and land in the study area such as Loni, Hapur Muradnagar etc. So to overcome the problem in these areas, one should explore the possibilities towards using organic and green manure more and more which keeps the balance of physical and chemical properties of land and soil intact. To supplement the nutrient the farmers in these

areas, should use mixed doses of chemical fertilizer along with organic manure. Other than this bio-fertilizers which are effective, cheap and renewable should be used to supplement the chemical fertilizers.

7. Mismanagement of water irrigation has created problems like water logging and salinity due to increased water table (Ground water table and surface water) and made cultivated area into non-cultivated area in areas like Garhmukteshwar, Hapur, Loni, Dholana blocks. Thus, to overcome the problems, efficient water management in irrigated areas and irrigation resource development should be needed. Some modern irrigation methods like sprinkles, drip etc. may help in attaining high application efficiency and avoiding soil degradation.

The above are some of the major and minor ecological problems facing the agriculture which we feel, are tackled by the Government, better results would be achieved.

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